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THE BIRDS OF NEW GUINEA.

By G. S. Mead.

(*Continued from page* 9).

No one is more deserving of the honor of having a bird of paradise named after him than Mr. Wallace. Such an honor, it is true, is not an extraordinary one in his case, being scarcely more than the customary recognition of a first discovery, but at all events it serves to remind us how closely he has identified himself with a beautiful family of birds, while his still greater labors for knowledge have already secured the reward of preëminence in the field of science where excellence is not always remembered by the world at large.

In "The Malay Archipelago," the author has told of his accidental discovery in the island of Batchian of a new species which was called from his name *Semioptera wallacei.* This was as along ago as 1858, and in all the intervening years no one has succeeded in making the bird a familiar inmate of museums. It is not of remarkable beauty, although its appearance is, in one respect at least, strangely peculiar, viz., in that which gives it the name Standard-wing. This curious formation is not a wing at all, but two flexible feathers springing from either shoulder, six inches in length and quite distinct from every other part of the plumage. As they stand out, swaying slightly to every movement, they look not unlike

four narrow ribbons of unequal width, that had somehow become entangled on the back of the bird. They are of a whitish color, a pleasing contrast to the sober hue of the upper parts, and especially to the vivid greens and emeralds of the breast and throat.

A two-fold shield extends its points several inches on either side after the fashion of the Superb bird of paradise. This targe sparkles with radiance, but aside from it and a less observed gleam of violet on the head, the Standard-wing is comparatively plain; perhaps no other species wears such a quaker garb. Short, recurved feathers impinging upon the bill, cover the forehead. The tail is stiff and square, and nearly overlapped by the wings. Both have white shafted feathers. Altogether the bird is destitute of the rich coloration of others of its tribe, save in the deeply forked pectoral shield, which, however, in its intense, sparkling lustre, makes partial amends. This is contrasted with the uniform drab of the rest of the plumage with striking effect. Herein lies the beauty of the *Semioptera*. Its oddity rests in the extraordinary standard-wing plumes. For about half their length, these widen out oar-like in white feathers, the remaining part up to the body consisting of the bare quill-shaft. The bird is almost a foot in length, the native of Gilolo being larger than that from Batchian and more strongly marked. It is remarkable, as Mr. Wallace points out in his admirable account, that this is the only species of paradise birds known beyond the borders of Papua and Northern Australia. Its habits are active, and its dissonant voice keeps pace with its movements. It may frequently be seen flitting rapidly among low tree-branches or clinging to the boughs. The female is in plain colors with scarcely a gloss on her feathers, excepting the crown, and is entirely without shield, alar plumes or green glaze.

Among the true birds of paradise, Mr. Wallace classes *Diphyllodes wilsonii* and calls it a distinct species, "still more rare and beautiful" than the Magnificent, which it resembles in size and plumage. This bird, strangely enough, was first 'discovered' in Philadelphia, where, however, it must be con-

fessed, it is not native. It has been rediscovered since in Waigiou and Batanta. The anomalous feature characterizing the Red Magnificent or Schlegel's Paradise bird—a better name—as it is sometimes called, and setting it entirely apart from its relations, is its bald head. This might seem a sad blemish to beauty, but as if to atone for a caprice, nature has painted the spot a deep blue and intersected it with lines of dark feathers. The wings, back, and lesser fringe are blood-red, hence the specific term, with dark shadings; the mantle springing from the neck is a bright yellow, while the breast reveals emerald and all its reflections in its dark depths. These are the predominant tones, but they emit and shade off into a hundred transitory hues, the metallic surface changing fitfully with every changing light. Around this breast shield runs a narrow fringe of dark, thin filmy plumes, cut like a pattern with waving edges of an old-gold color. The tail is brown, squared but with rounded corners; from the rump two centre feathers much elongated and very narrow project, cross each other twice and then become involved in an incomplete circle. These curious appendages are much shorter than those of the Magnificent Paradise-bird, but are curved with even greater elaboration, though lacking the bold, sweeping lines of that fine species.

The bird is a small one, not much over seven inches in length; the female equals her mate in size, but, of course, is deficient in every other respect with this exception, that she is partially bald. Her dress is a uniform brown and yellow, with gray speckled breast.

In taking leave, for the present, of the birds of paradise, mention may be made of the Paradise Oriole, *Sericulus aureus*, a separate genus but bearing certain marks of a character similar to the group already considered. Mr. Stone records the bird as found in southern New Guinea, although he does not appear to have collected it, while Mr. Wallace ascribes it to Salawatti as well, noting at the same time that it is excessively rare. In general coloring it is like our Baltimore Oriole, with an admixture of the flaming Scarlet Tanager (being still more in the tone of orange, like the Cock-of-the-rock)

a brilliant contrasted gold and black, the brighter hue predominating. Here the resemblance ceases, and affinity with the *Paradisea* is suggested in the long thickly folded plumes of a deep shining yellow, running in rippling lines of light down the neck and back, and forming a large dorsal shield or mantle. Of the same fiery orange-red are the longer side plumes. A lighter tint intermingled with black prevails on the rump, tail coverts and scapulars. Jet black marks the throat and the side face enclosing the eye. An inch wide streak of the same runs along the side of the body as far as the tail. The under parts are an orange-yellow. It will be seen, therefore, that *Xanthomelus aureus,* as he is also termed, is a very showy fellow. To add to his port, he is adorned with an erectile crest like that of the Blue-jay, excepting in color. In size he is about the same as that denizen of our forests. He carries himself too with as much alertness and can be as noisy on occasions, though ordinarily he is incurious and evasive. He is thought to build some kind of a bower, but this is not positively known. His note is clear and resonant. The female is a very pale reflection of her beautiful mate.[1]

Allusion has been made several times in these pages to Mr. Octavius Stone. This gentleman visited Southeastern New Guinea twice, and twenty years ago his collection of birds was, perhaps, the most considerable that had been gathered up to that time. He secured 116 species, among them some either entirely unknown or never seen before in England. Among these was a new Catbird, named from its discoverer *Aeluroedus stonii.* This interesting little stranger may claim affiliation with the Bower birds, and through them with the *Paradiseidae.* It does not, however, construct a bower. In size it is smaller than *Aeluroedus buccoides* (Temm.) a species more common in New Guinea, especially in the northwestern part. The length is between nine and ten inches. As one takes up the

[1] *Oriolus aureus* and *xanthogaster* (Vide, p. 393, Vol. XXVIII, American Naturalist) are probably one and the same, the latter being now regarded as the young of this lovely bird which is burdened with many other synonyms besides those already mentioned.

skin of this bird, he might deem it that of some small parrot, the thick, white, curved beak assisting that impression. The upper parts are a lively green, growing dark on the extremities of the wings and tail; a touch of blue and yellow appears here and there. The head is a dull black, the throat a spotted black and white. Yellow is the prevailing color beneath, speckled with black and green. These tints cover the nape of the neck, the black in streaks running like so many short strings of beads on a yellow ground. White shows on the throat and side face dotted with dark spots. The tail is short and square. The same terms apply to the form of the bird. The female is of the same size and figure.

Aeluroedus buccoides or Barbet-like cat bird of Western New Guinea has the spots on the throat and under parts much larger than those on the preceding species. The head is olive-brown, the wing coverts a uniform green; length ten inches.

In *Aeluroedus melanocephalus* we must first notice its specific characteristic—the black head—in which, however, it is not singular, *arfakianus* being marked in like fashion. It has green wing-coverts, dark olive-brown under parts, black-tipped feathers on the throat, the ground color being white, the black running only as a narrow stripe or figure.

Every one has heard of the Bower-bird—*Chlamydera*—who constructs a play-ground or garden of delight, adorning it with all sorts of attractive objects either for his own whimsical purposes or to please his mate. The bower is some little distance through, perhaps thirty inches along the ground, and is composed of short twigs and sticks so placed as to form a half-roofed tunnel. Here the bird passes much of his time, diverts his mate by adding to their resort or by showing the gay material he has picked up, and in various ways manifests his appreciation of his own ingenious devices. He is a plain fellow in his own dress, though his taste is for the gaudy and meretricious; his size too, is small in proportion to the Castle of Indolence he rears, for this is no nest—this retreat of his, but a pleasure-house, a place of retirement, quiet amusement, or rollicking sport. His nursery is a different thing altogether, and is placed elsewhere. In his bower he

gives his fancy full swing; he brings hither to garnish it every bright article he can discover, and lays a considerable territory under tribute to minister to his beloved habit, and so prodigal is he of his acquired treasures that the approaches to his singular abode are strewn with spoils. Nothing seems to come amiss, hence he is as eager to possess himself of old bones, shells, stones, and all kinds of miscellanea, as bits of metal, flowers, leaves, dropped feathers, etc., although as a rule, glittering objects prevail, obviously collected for decorative purposes. It is apparent that with so much evidence in plain sight, the little builder could not well conceal his structure, nor indeed was it the probable intention to do so; it was far easier to hide the real nest, and this has been done so effectually that the most persevering efforts towards discovery have gone unrewarded. It is not likely, however, that arbor and nest are very far apart.

The *Chlamydera cerviniventris* or Fawn-breasted Bower-bird is enough like the common female robin of this country to be mistaken for her. The bird is very plain throughout, the nearest approach to brightness, and that but slight, being on the breast and abdomen, where a brownish-yellow tinge occurs. The buff throat is streaked with dull yellow. The upper parts are uniformly drab or slate. It is rather longer than our robin—about twelve inches—with tail and wings extended more than strict proportions would permit. The bill is short and black, eyes are dark, legs and feet black. The male is said to sing sweetly, thus adding another accomplishment to his faculty of pleasing his mate as well as himself.

Another Bower-bird of New Guinea is the Gardener—*Amblyornis inornatus*—who builds his hut or arbor of a triangular shape, set back against the trunk of a tree; in front he scatters the usual assortment of shining, smooth, and curious objects together with perishable substances, such as small plants, flowers, insects, fruit and fungi, removing them carefully when they become offensive or timeworn. This little virtuoso is plain in color, a yellowish-red predominating, and in size and general appearance not unlike a large Brown Thrasher. He seems always busy and, indeed, must be, for the nature of his

work requires unflagging diligence, but the time of greatest activity probably is during the pairing season.

The best authorities describe the cabin of the Gardener as built around the central stem of some bush, or as enclosing a cluster of shoots; in front the garden is placed, and is set out with that strangely rational, though fantastic system of horticulture that has gained the bird its name. If there is no growth in the garden, we may infer that this branch of cultivation formed no part of the grand design; the results were all that was sought and these were to be always above ground. These birds have been classified by some naturalists with the *Paradisea*, though nothing in their appearance, habits or song (they are said to sing sweetly) seems to bear out such assignment.

This curious and fascinating bird is very local in its range, being confined so far as known to the Arfak Mountains in the northwest of New Guinea. It is only of recent years that it has been studied by scientifically; Mr. Wallace knew nothing of it nor have naturalists since his visit to the great island added much to our knowledge. Dr. Becceari was the first to introduce the Gardener to the world, and his graphic account of the abode of the little artificer has not been surpased in merit nor greatly amplified in details by subsequent investigators. The Italian traveller, as in a picture, shows the hut or cabin close upon a small, flower besprinkled meadow. It is built around the stem of a little tree as thick and tall as an ordinary walking-stick. The materials used are moss chiefly, and form a structure about three feet in diameter. In shape the nest is conical, reminding one irresistibly in its whole appearance of the head covering Robinson Crusoe is usually represented as wearing. Inside is a little gallery or runway built along the walls. The garden is arranged before the hut decked out as we have seen. Amblyornis—simple in attire and coloring as his specific name indicates—is now a favorite illustration with theorists of the adaptation of animate life to its surroundings. Certainly its dun and sober clothing assimilates easily with the tones of soil and vegetation around. Its home

too with all its adornments harmonizes with, indeed, forms a part of the gay green wood.

A very interesting little group of passerine birds belonging to the family of *Prionopidae* are the *Rectes,* of which there are several species common to New Guinea and the adjacent islands. Near his camp at Narinuma on the southern side of the mainland, Mr. Denton first saw "brown birds with black heads" sitting close together and keeping up a constant whistle, very soft and prolonged. The sound he describes as not unlike a steamboat whistle a great distance away. It seemed almost impossible for a small bird to produce such a sound. All travellers have met one or another of the several varieties in different parts of the island. Probably Mr. Denton's bird was *Rectes cirrhocephalus* or *dichrous,* if these are not one and the same bird. The former, indeed both species, while not brilliantly clad, possesses a singularly rich golden-brown dress contrasted with the jet black of the head, wings and tail. When the bird flies through the sunshine this warm plumage lights up with wonderful effect. Then the entire body is displayed, and is seen both above and below to be full of all the tints from maroon to orange. Black again appears on the throat extending well down on the breast. The bill is also black. The tail, black above and below, is long and narrow. A whitish feather might be traced on the inner wing of the skins examined. The female is almost the counterpart of the male, the points of difference being so slight as to make identification of the sex in life no easy matter. The bird is between nine and ten inches in length.

A somewhat larger species is to be noticed in *Rectes uropygialis,* the Rufous and black wood Shrike, whose favored habitat is the little island of Mysol, lying a considerable distance to the west of New Guinea. In this instance, similar colors and a similar disposition of colors prevail, with the black, however, running a little farther upon the body. The head is ruffled by a longitudinal crest of black feathers as in the preceding.

But in place of the ruddy glow of the foregoing, we have in *Rectes cerviniventris,* or Fawn-breasted Wood Shrike a subdued olive or even ashy gray for the general coloring. On

tail, wings and under parts we observe a stain of brown and dull red, paling here and there into mauve or ash. This little bird, not much more than eight inches long, nearly half of which is tail, is a native of Waigiou, but probably he extends his wanderings throughout most of Papua. A crest marks this species also.

THE HEREDITARY MECHANISM AND THE SEARCH FOR THE UNKNOWN FACTORS OF EVOLUTION.[1]

By Henry Fairfield Osborn.

"Disprove Lamarck's principle and we must assume that there is some third factor in Evolution of which we are now ignorant."[2]

Chief among the unknown factors of evolution are the relations which subsist between the various stages of development and the environment.

A study of the recent discussion in the *Contemporary Review* between Spencer and Weismann leads to the conclusion that neither of these acknowledged leaders of biological thought supports his position upon inductive evidence. Each displays his main force in destructive criticism of his opponent; neither presents his case constructively in such a manner as to carry conviction either to his opponent or to others. In short, beneath the surface of fine controversial style we discern these leaders respectively maintaining as finally established, theories which are less grounded upon fact than upon the logical improbabilities of rival theories. Such a conclusion is deeply significant; to my mind it marks a turning point in the history of speculation, for certainly we shall not arrest research with any evolution factor grounded upon logic rather than upon inductive demonstration. A retrograde chapter in the history of science would open if we should do so and should accept as established, laws which rest so largely upon negative reasoning.

The growing sentiment of the necessity of induction and of inductive evidence is the least conspicuous, but really the most

[1] From the "Biological Lectures" of Marine Biological Laboratory, Woods Holl. This lecture is mainly from an article published by the author, in Merkel u. Bonnet: *Ergebnisse fur Anatomie und Entwickelungsgeschichte*, Freiburg, 1894, and partly from a paper before the Biological Section of the British Association for the Advancement of Science: Certain Principles of Progressively Adaptive Variation observed in Fossil Series. *Nature*, August 30, 1894.

[2] Osborn: Are Acquired Variations Inherited? Address before the American Society of Naturalists. *Amer. Naturalist*, February, 1891.

important and lasting outcome of this prolonged discussion. Weismann is the real initiator of this outcoming movement although it has taken a radical direction he neither foresaw nor advocated, for his position is eminently conservative. In fact his first permanent service to Biology is his demand for direct evidence of the Lamarckian principle, which has led to the counter-demand for such evidence of his own Selection principle, which by his own showing, and still more by his own admission in this discussion with Spencer, he is unable to meet. His second permanent service, as Professor E. B. Wilson reminds the writer, is that he has brought into the foreground the relation between the hereditary mechanism and evolution.

What have we gained in the controversy of the past decade unless it is closer thinking and this keener appreciation of the necessity for more observation? We carry forth, perhaps, some new and useful working hypotheses as to possible modes of evolution, and a fuller realization of the immense difficulties of the heredity problem—but these are only indirect gains. It is a direct gain that these negative results have led a minority of biologists into a total reaction from speculation and into a generally agnostic temper towards modern theories which is far more healthy and hopeful than the confident spirit of the majority upon either the Neo-Lamarckian or the Neo-Darwinian side. There is no note of progress in the dogmatic assertion that the question is established either as Spencer or as Weismann would have it, unless this assertion can be backed up by proof, and by whom can proof be presented if not by these masters of the subject? The conviction we all reach when we sift wheat from chaff, and bring together from all sources phenomena of different kinds and seek to discern what the exact bearings of these phenomena are, is that we are still on the threshold of the evolution problem, and that the secret is largely tied up with that of vital phenomena in general.

The very wide and positive differences of opinion which prevail are attributable largely to the unnatural divorce of the different branches of biology, to our extreme modern specialization, to our lack of eclecticism in biology. We begin to grasp the magnitude of the problem only when side by side

with field and laboratory data are placed paleontological data, as well as anthropological, including the unique facts of human variation and the laws of human inheritance. For in modern embryology certainly the most brilliant discovery is that the physical basis of all inheritance is the same—and growing out of this is the high probability that the laws of heredity are the same in the whole organic world, with no barriers between protozoa and metazoa, or between animals and plants. Both Weismann and Spencer show themselves blind to this nexus of fundamental uniformity when they draw certain lines of division in inheritance where none exist in the visible hereditary mechanism of chromatin and archoplasm. With these discoveries in mind does not Weismann appear as much afield when he maintains that the inheritance of acquired characters is a declining principle in the ascent of life, as Spencer when he maintains that it is a rising principle in the ascent of life?

The first step then towards progress is the straightforward confession of the limits of our knowledge and of our present failure to base either Lamarckism or Neo-Darwinism as universal principles upon induction. The second is the recognition that all our thinking still centers around the five working hypotheses which have thus far been proposed; namely, those of Buffon, Lamarck, St. Hilaire, Darwin, and Nägeli. Modern criticism has highly differentiated, but not essentially altered these hypothetical factors since they were originally conceived. Darwin's 'survival of the fittest' we may alone regard as absolutely demonstrated as a real factor, without committing ourselves as to the 'origin of fitness.' The third step is to recognize that there may be an unknown factor or factors which will cause quite as great surprise as Darwin's. The feeling that there is such first came to the writer in 1890 in considering the want of an explanation for the definite and apparently purposeful character of certain variations.[3] Since then a similar feeling has been voiced by Romanes and others, and quite lately by Scott;[4] but the most extreme expression

[3] *Op. cit.*, 1891.

[4] On Variations and Mutations. *Am. Jour. Sc.*, November, 1894.

of it has recently come from Driesch[5] in his implication that there is a factor not only unknown but unknowable!

Theoretically neither of these five hypotheses of the day excludes the others. They may all coöperate. The role which each plays, or the fate of each in the history of speculation largely or wholly depends upon the solution of the problem of the transmission or non-transmission of acquired variations and after all that has been written on this question this must be regarded by every impartial observer as still an open one.

We are far from finally testing or dismissing these old factors, but the reaction from speculation upon them is in itself a silent admission that we must reach out for some unknown quantity. It such does exist there is little hope that we shall discover it except by the most laborious research; and while we may predict that conclusive evidence of its existence will be found in morphology, it is safe to add that the fortunate discoverer will be a physiologist.

The Analysis of Variation.

After this introductory survey let us consider as another outcome of the controversy that Variation and the related branch of research, Experimental Evolution, are now in the foreground as the most important and hopeful of the many channels into which the inductive tests of known or unknown factors may be turned. Let us make an honorable exception of those reactionists, such as Bateson[6] and Weldon, who have instituted an exact investigation into the laws of Variation.

How shall the study of Variation be carried on? I totally differ at the outset from Bateson in the standpoint taken in the introduction of his work, that the best method of starting such an investigation is in discarding the analysis which rests upon the experience as well as the more or less speculative basis of past research. There is little clear insight to be gained by considering variations *en masse*, and in this lecture I shall put forth some reasons why this is the case as well as some prin-

[5] Analytische Theorie der Organischen Entwickelung. Leipsic, 1894.

[6] W. Bateson: Materials for the Study of Variation, London, 1894.

ciples which seems to be preliminary to an intelligent collection and arrangement of facts, upon the ground that a mere catalogue of facts will have no result. Variation is to be regarded as one of the two modes or expressions of Heredity, or as the exponent of old hereditary forces developing under new or unstable conditions. It stands in contrast not with Heredity, which includes it, but with Repetition as the exponent of old forces developing under old or stable conditions. Nägeli ten years ago[7] laid stress upon this, as have latterly Weismann, Bateson, Hurst,[8] and others. Nevertheless it is still widely misconceived. Hurst even regards Variation as the oldest phenomenon—an error in the other extreme, for they are rather coincident phenomena—representing the stability or instability of development. The broadest analysis we can make is that variations are divided by three planes—the plane of *time*, the plane of *cause*, and the plane of *fitness*. This raises the three problems to be solved regarding each variation; when did the variation originate? what caused it to originate? is it or is it not adaptive?

The student of heredity, in connection with these three planes of analysis, has then to consider the modes of heredity as complementary or interacting, for as soon as a 'variation' recurs in several generations it is practically a 'repetition,' and the repetition principle is a frequent source of apparent but not real variation or departure in the offspring from parental or race type. This relation becomes clear when we consider variations in man as seen in Anatomy and in Galton's studies of inheritance and as expressed in the following table:—

[7] "Vererbung und Veränderung sind, wenn sie nach dem wahren Wesen der Organismen bestimmt werden, nur scheinbare Gegensätze." *Theorie der Abstammungslehre*, p. 541.

[8] Biological Theories. I, The Nature of Heredity. *Natural Science*, vol. I, No. 7, September, 1892. II, The Evolution of Heredity. *Natural Science*, vol. I, No, 8, October, 1892

HEREDITY.

Repetition.	*Variation.*	
A. Retrogressive to present and past type.	*A*. Neutral both as regards present or future type. Including anomalies and abnormalities which are purely individual phenomena not in the path of evolution.	*B*. Progressive to future type.
(*a*) Repetition of parental type.		(*a*) Ontogenic variation from parental type in one or more characters.
(*b*) Regression to present race type usually in several characters(=Variation from present *parental* type).		(*b*) Ontogenic variation from present race in several characters (=a new sub-type).
(*c*) Reversion to past race type, usually in few or single characters (=Variation from present *race* type).		(*c*) Phylogenic or constant variation towards future race type, in one or more characters, constituting a new 'Variety' (=Repetition of parental type).
Palingenic Variation.		*Cenogenic Variation.*

The most profound gap in time is between 'palingenic variations,' springing from the past history of the individual, and 'cenogenic variations,' which have to do only with present and future history. The former embraces more than reversion. This table gives us only our first impression of this plane of time so lightly regarded by Bateson, if indeed discrimination is possible among data of the kind he has collected. The distinctive import of human anatomy[9] is that a comparison of the past and present habits of the race, or of the uses to which bones and muscles have been and are now being put, opens a possible analysis of variations both as regards their time of origin and as regards their fitness to past, present, or future uses; it is thus an inexhaustible mine for the philosophical study of variation—of which only the upper levels have been worked.[10] Beside the human organism there is no other within

[9] R. Wiedersheim: Bau des Menschen als Zeugniss seiner Vergangenheit. Freiburg, 1887.

[10] H. F. Osborn: Present Problems in Evolution and Heredity. The Cartwright Lectures. I. The Contemporary Evolution of Man, etc. Wm. Wood & Co., New York, 1891.

our reach admitting such exact analysis of variation in the planes of time and fitness. When, again, we connect human anatomy as a field for the study of Variation with Galton's researches, although his emphasis has been chiefly upon the laws of Repetition, we begin to appreciate the far-reaching importance of his inductions. In contrast with those of Weismann they are based upon facts and will stand. In the first volume of these Marine Biological Laboratory lectures I went into some detail to show how Galton bears upon the modern evolution problem, so that here I may briefly recapitulate. He demonstrates two principles: First, that there must be some strong progressive variational tendency in organisms to offset the strongly retrogressive principle of Repetition wherever the neutralizing or swamping effect of natural inter-breeding is in force, as it virtually is for most anatomical characters of the human race. Second, he shows what has not been pointed out in this connection before, that in natural inter-breeding ontogenic or individual variations are conspicuous but in the main temporary, while there is a strong undercurrent of phylogenic variations relatively inconspicuous and permanent. Other evidence supporting this latter principle comes out as we proceed.

What is the value of a distinction between *ontogenic* and *phylogenic* variations? It is this: it sets forth the widely neglected initial problem of the *time of origin of a variation in the life history of the individual.* This is the first step in experimentation upon variation, not only as it will afford crucial evidence as to the factors of Buffon, Lamarck, and of St. Hilaire, which hinge upon the inheritance of acquired variations, but in the coming days of exact research upon Variation in general. Let *ontogenic variation*—a term first used by Brooks, I believe, although I cannot point out where—include all deviations from type which have their cause in any stage of individual development. We are now beginning to fully recognize that the causes of certain kinds of variation actually can be traced to external influences upon certain stages of growth or ontogeny, and that it will be possible ultimately to determine these stages when this matter of time is established

by experiment. Let *phylogenic variation*—a term first used by Nägeli[11]—include those departures from type which have become constant hereditary characters in certain phyletic series or even in a few generations. While all phylogenic variations must originate in ontogeny or in some stage of individual development, certainly a very small proportion of the innumerable ontogenic variations which we find in the examination or measurement of any adult individual ever become phylogenic, or constitute more than ripples upon the surface of a tide.

This vital distinction has not been regarded hitherto. The statistics of variation, as compiled by Darwin and lately by Wallace, Weldon, Bateson, and others, do not take into account that among phylogenic variations are others purely ontogenic springing up and disappearing during individual life, owing to causes connected solely with the disturbance of the typical action of the hereditary mechanism during ontogeny. In other words, these writers have without discrimination based upon variations, which may be largely or wholly ontogenic and temporary, the important principles of 'Fortuitous Variation' of Darwin and of 'Discontinuous Variation' of Bateson, whereas it is only the laws of phylogenic variation which are of real bearing upon the problem of evolution. Take as an illustration of this false method the wing measurements of birds given by Wallace. Why may not these be largely cases of purely ontogenic variation due to influences of life habit or to some purely temporary disturbance of the hereditary basis? Above all others, the Neo-Darwinians must reconsider their principle of 'fortuitous variation' which is an induction from data of miscellaneous ontogenic and phylogenic variations, because Neo-Darwinism is essentially and exclusively a theory of the survival of favorable phylogenic variations.

[11] Die Veränderung, die gewöhnlich der Vererbung gegenüber gestellt wird, steht nicht im Gegensatz zu dieser, sondern zur Constanz. In diesem Sinne heisst eine Veränderung constant, wenn das Gewonnene dauernd behalten, und vergänglich, wenn es bald wieder preisgegeben wird. Die constante oder die *phylogenetische Veranderung* . . . ist eigentlich nichts anderes als die Constitutionsänderung des Idioplasmas. *Theorie der Abstammungslehre*, p. 277.

One aspect of the variation problem of to-day may, therefore, be stated thus: What is the cause, nature, and extent of ontogenic variations in different stages of development, and under what circumstances do ontogenic variation become phylogenic?

This brings us to an analysis of ontogenic variations in the *plane of time* as provisionally expressed in the following table:—

ORIGIN OF VARIATIONS DURING LIFE HISTORY.

A. Ontogenic Variations.	*Theories of Causation.*
(*a*) *Gonagenic, i. e.*, those arising in the germ-cells, including the 'Blastogenic' in part of Weismann, the 'Primary Variations' of Emery.	Theoretically connected with pathological, nutritive chemico-physical, nervous influences, as implied by Kölliker and others, including the doubtful phenomena of Xenia and Telegony.
(*b*) *Gamogenic, i. e.*, those arising during maturation and fertilization, including the 'Blastogenic' in part of Weismann, 'Secondary,' or 'Weismannian variations' of Emery.	Theoretically connected with influences named above, also with the combination of diverse ancestral characters, 'Amphimixis' of Weismann.
(*c*) *Embryogenic, i. e.*, those occurring during early cell division, including the 'Blastogenic' and 'Somatogenic' in part of Weismann.	Theoretically connected with extensive anomalies due to abnormal segmentation and other causes, as observed in the mechanical embryology of Roux, Driesch, Wilson, and others.
(*d*) *Somatogenic, i. e.*, those occurring during larval and later development after the formation of the germ-cells.	Connected with reactions between the hereditary development forces of the individual and the environment.

B. Phylogenic Variations.

Variations from type originating in any of the above stages which become hereditary.

The above table illustrates limits which certainly should not be sharply drawn between the successive stages of ontogeny, although intermediate focal points of real distinction must exist. The four terms proposed are not in the sense of the 'blastogenic' and 'somatogenic' of Weismann, for there is no implication of his *petitio principi*, namely, of the separation of the hereditary substance or specific germ-plasm from the body-cells. Even before somatogenic separation has taken

place we have little or no reason to believe that all the blastogenic, gonagenic, or gamogenic variations which may have arisen from various causes will become phylogenic.

If we carry our analysis into the '*plane of fitness*' the first point which arises is whether variations are *normal*, including both cenogenic and palingenic variations, or *abnormal*, including teratological and other malformations. The terms 'fortuitous' and 'indefinite' as opposed to 'determinate' and 'definite' may be used apart from any theory, although they have sprung up as distinguishing two opposed views as to the principles of variation. 'Fortuity' strictly implies variation round an average mean, while 'definite' is not the necessary equivalent of adaptive, but simply implies progressive or phylogenic variation in one direction which Waagen and Scott have termed "Mutation." Bateson's terms 'Continuous' and 'Discontinuous' are useful as distinguishing gradual from sudden ontogenic variation.

In general our five working hypotheses as to the factors of evolution are theoretically related to the time stages of Variation as seen in the following table :—

Buffon's	*Ontogenic*	
	a Gonagenic	
	b Gamogenic	
	c Embryogenic	St. Hilaire's
	d Somatogenic	Lamarck's
Darwin's	*Phylogenic*	

I again call attention to the fact that Neo-Darwinism has hitherto presupposed and practically assumed 'fortuitous phylogenic variation' as its basis, for it is solely related with the selection of those ontogenic variations which are also phylogenic. Neo-Lamarckism, on the other hand, is solely connected with inheritable 'somatogenic' variation. Buffon's factor of the 'direct action of the environment' plays upon all four ontogenic stages, and both theoretically and as observed by experiment, produces profound ontogenic variations; the question is, under what circumstances do such ontogenic variation in each of the four stages become phylogenic? This

factor would be partly but not wholly set aside by proof that somatogenic variations are not inherited. St. Hilaire's factor of the action of environment upon early stages of development would result in purely fortuitous variations, and, as he himself clearly perceived, would require Selection to give it an adaptive direction. Nägeli's factor, on the other-hand, assumes definite but not necessarily adaptive 'phylogenic' variation—his views have been very generally misconceived on these points —and, as he pointed out, his factor would also require Selection to determine which of the definite lines of growth were adaptive.

It seems necessary to thus clearly state the relations of the time stages of variation to each of the five factors, in order to show the decisive bearings our future exact research will have upon them. For example, the proof that variation is either 'definite' or that it is 'adaptive' prior to or independently of Selection, will constitute conclusive disproof not of Darwin's theory but of Neo-Darwinism. The fate of Lamarckism, on the other hand, depends upon the demonstration that phylogenic variation is not only 'definite' and 'adaptive' but that it is anticipated by corresponding somatogenic variation.

A review of recent thought upon the variation problem shows that these life stages are becoming generally recognized. I shall pass by Lamarck's and Darwin's factors which are so thoroughly understood and speak only of the other three.

Buffon's Factor in Variation.

As regards Buffon's factor, which is the most comprehensive of all, we know that Spencer and Weismann both assumed that the direct action of the environment was primarily a factor of evolution. Weismann first regarded this solely as the protozoan source of Variation, but has recently given it a wider play in the action of environment upon the germ-cells as a cause not of definite variation but of variability. The line of research upon the dynamic action of environment in its influence upon somatogenic variation followed by Hyatt, Dall, and others, is paralleled in the more recent specula-

tion connecting the environment directly with gonagenic and gamogenic stages, initiated by Virchow,[12] Kölliker,[13] Ziegler,[14] Sutton, and others. In a similar vein are the suggestions of Geddes, while those of Gerlach and Ryder direct our attention mainly to mechanical alterations in the embryonic stages of development. Botanists such as Vines, Detmer, and Hoffmann have pointed to the influence of environment upon gonagenic variation. Experiments of a general character resulting principally in embryogenic and somatogenic variation have been recently carried on by Cunningham, Agassiz, and others, as illustrating the direct action of the environment. Followers of Buffon's factor are also more or less identified with Lamarckism. The distinction is mainly expressed in the terms 'kinetogenic' and 'statogenic' of Cope and Ryder; for under Buffon's factor the organism is passive, while under Lamarck's it is active. Among others who have supported Buffon's principle are Packard, Eimer, Cunningham, Ryder, and Dall.

This literature and so-called 'evidence' upon Buffon's factor exhibits the greatest confusion of interpretation, and demonstrates that our conceptions first, as regards heredity, second, as regards variation under a changed environment, require thorough recasting.[15] First as regards evolution in relation to heredity. The reversion phenomena as seen in human anatomy wholly set aside Weismann's conception of evolution as the selection of favorable and the elimination of unfavorable hereditary variations; in other words, of selection acting directly upon the germ-plasm. These phenomena indicate rather that the direct process is not one of elimination but of suppression from the later stages of ontogeny, and that only

[12] R. Virchow: Descendenz and Pathologie. *Virchow's Archiv*, CIII, p. 1886, pp 1-15, 205--215, 413--437. Ueber den Transformismus. *Archiv f. Anthropologie*, 1889, p. I.

[13] Kölliker: Das Karyoplasma und die Vererbung. *Zeitschr. f. wissenschaftl Zoologie*, 1886. Eröffnungsrede der ersten Versammlung der Anatomischen Gesellschaft in Leipzig. *Anat. Anzeiger*, II, 1887.

[14] Ernst Ziegler: Die neuesten Arbeiten über Vererbung und Abstammungslehre und ihre Bedeutung für die Pathologie. Tübingen.

[15] J. T. Cunningham: The Problem of Variation. *Natural Science*, vol. III, pp. 282--287. Also, Researches on the Coloration of the Skins of Flat-Fishes. *Jour. Mar.* Biol. *Assoc.*, May, 1893. (See also *Trans. Roy. Soc.*, 1892-3).

after an enormous interval of time does actual elimination occur. Abnormal nervous conditions such as seen in Anencephaly are accompanied by the revival of a large number of latent characters. In Galton's language, patent characters become latent in the course of evolution.

In Weismann's language, on the other hand, in explanation of dimorphism in hymenoptera and other types, there are certain sets of biophors corresponding to certain possibilities of adult development. Apply this to the celebrated case of the flat-fishes and the remarkable results recently obtained by Agassiz, Filhol, and Giard in artifically producing more or less symmetrical flat-fishes by retaining the young near the surface. Weismann's interpretation of the evolution of flat-fishes has always been that it was by the selection of asymmetrical and elimination of symmetrical 'determinants.' In the light of these experiments he must now recast this explanation by saying that the flat-fishes have kept in reserve a set of symmetrical 'determinants' since the period when our first record of the asymmetrical type appears, or about three million years!

This attack upon the speculations of one writer is a digression. What I really wish to bring out is the necessity of a far more critical analysis of the various kinds of evidence for Buffon's factor. This necessity may be illustrated by the different interpretations of color change in direct response to changed environment.

The most significant experiments upon color are those of Cunningham upon the flat-fishes. He has proved that during the early metamorphosis of young flat-fishes, when pigment is still present on both sides, the action of reflected light does not prevent the disappearance of this pigment upon the side which is turned towards the bottom, so that the color passes rapidly through a retrograde development; but prolonged exposure to the light upon the lower side causes the pigment to *reappear*, and upon its reappearance the pigment spots are in all respects similar to those normally present upon the upper side of the fish. It is very important not to confuse these results, of deep interest as they are, with those obtained where the environment is new in the historic experience of the organ-

ism. Experiments upon color, therefore, afford a marked illustration of the necessity of drawing a sharp distinction between cenogenic and palingenic variations. We have, in many cases, been mistaking repetitions of ancient types of structure for newly acquired structures. When the pale *Proteus* is taken from the Austrian caves, placed in the sunlight, and in the course of a month becomes darkly pigmented, there are two interpretation of this pigmentation; either that we have revived a latent character, or that we have created a new character. The latter interpretation can alone be taken as a proof of Buffon's factor when it is found to be followed by hereditary transmission.

Poulton,[16] as a supporter of Neo-Darwinism, takes this view, in reply to Beddard and Bateson, and as an induction from his beautiful and exact experiments upon the coloring of lepidopterous larvæ. After producing the most widely various colorings and markings by surrounding the larvæ during ontogeny with objects of different colors, he urges that the changes thus directly produced simply revert to adaptations to former conditions of life, in other words, that they are palingenic. Whether this interpretation is correct or not, Poulton proves that, no matter how stable certain hereditary characters may appear to be, repetition in ontogeny depends upon repetition in environment, and that there are wide degrees of ontogenic variations which do not become phylogenic at least in several successive generations.

From many other analogous researches we gather the following principle to which far too little attention has been paid in the study of the phenomena of variation in their bearing upon the factors of evolution: *It is that ontogenic repetition depends largely upon repetition in environment and life habit, while ontogenic variation is connected with variation in environment and life habit.* If the environment be changed to an ancient one, then ontogenic variations tend to regression or reversion (*i. e.*, palingeny) or practically to repetition of an ancient type. It

[16] E. B. Poulton: Further experiments upon the color-relation between certain lepidopterous larvæ, pupæ, cocoons, and imagines and their surroundings. *Trans. Ent. Soc.*, pt. IV, p. 293. London, 1892. (Contains a reply to Beddard and Bateson.)

is necessary to state clearly that there is practically conclusive evidence for such a principle, not only in the later stages of development, as in the respiratory metamorphoses of the Amphibia, but extending back to very much earlier stages than we have hitherto suspected. Thus a vast amount of evidence which has been brought forward as proof of Buffon's factor, *i. e.*, of the direct action of environment in producing definite and adaptive ontogenic variations is in reality in many cases no proof at all.

Having thus eliminated errors of interpretation, the great question still remains as to what happens when the environment is a wholly new one in the historical experience of the organism. Do the ontogenic variations exhibit a new direction? Is this direction adaptive, *i, e.*, towards progressive adaptation? What relations have such new conditions to the hereditary potencies of the germ-cells?

Out of all actual researches it becomes clear that experimentation can henceforth be separately directed upon the four stages of development, and that it will be possible in some degree to draw such lines of separation. New mechanical and chemical influences can be applied in each stage and withdrawn in the subsequent stages, the difficulty being to reach the extreme point where a profound influence is exerted without interfering with the reproductive function.

One effect of new environment upon the gonagenic, gamogenic, and embryogenic stages will be *saltation.* Ryder[17] has recently treated this in a most suggestive manner in discussing the origin of Japanese gold-fish. Turning to St. Hilaire's hypothesis, we find he had in mind embryogenic saltation mainly traceable to respiratory and chemical changes. Virchow extends the cause of sudden change further back to chemico-physical influences upon the germ-cells. The causes and modes of sudden development arising from whatever ontogenic stage demand the most careful investigation, chiefly in their bearing upon the relation of ontogenic to phylogenic variation.

[17] The inheritance of modifications due to disturbance of the early stages of development, especially in the Japanese domesticated races of gold-carp. *Proc. Acad. Nat. Sc. Phila.*, 1893, p. 75.

Galton has discussed the subject objectively under the head of 'Stability of Sports,' and Emery, under the head of 'Primary Variations,' has supported Galton's observation that such saltations often exhibit a strong capacity for inheritance. Bateson reaches in the conclusion of his work a modified form of St. Hilaire's factor of saltatory evolution, and believes that species have largely originated by 'discontinuity' of variation or the sudden accession of new characters from unknown causes, concluding that all inquiry into the causes of variation is premature. The materials he has brought together are of the greatest value, and he has already been able to throw in doubt many current beliefs, such as that variability is greater in domestic than in wild animals. His interpretation of these materials is, as we have seen, weakened, so far as it bears on our search for the evolution factors, by the fact that from the nature of most of his evidence he cannot discriminate between ontogenic aud phylogenic variation; moreover, he discards any attempt to discriminate between palingenic and cenogenic variations. This lack of analysis leads him into what appears to be an entirely erroneous induction, for the principle of discontinuity is opposed by strong evidence for continuous and definite phylogenic variation as observed in actual phyletic series.

Nageli's Factor and Phylogenic Variation.

Nägeli's factor[18] introduces us to an entirely distinct territory —to the opposite extreme from saltation. It is one we can no longer set aside as transcendental because of the strong likeness it bears at first sight to the internal perfecting principle of Aristotle. It is supported in a guarded manner by Kölliker and Ziegler. It contains the large element of truth that the trend of variation and hence of evolution is predestined by the constitution of the organism; that is, granted a certain hereditary constitution and an environment favoring its development, this development will exhibit certain definite directions, which

[18] C. v. Nägeli: Mechanisch-physiologische Theorie der Abstammungslehre. München und Leipzig, 1884.

when reaching a survival value will be acted upon by selection. I have recently[19] described as the '*potential of similar variation*' an evolution principle which seems to be well supported by palæontological evidence. It is this: while the environment and the activity of the organism may supply the stimuli in some manner unknown to us, definite tendencies of variation spring from certain very remote ancestral causes; for example, in the middle Miocene the molar teeth of the horse and the rhinoceros began to exhibit similar variations; when these are traced back to the embryonic and also to the ancestral stages of tooth development of an early geological period, we discover that the six cusps of the Eocene crown, repeated to-day in the embryonic development of the jaw, were also the centers of phylogenic variation; these centers seem to have predetermined at what points certain new structures would appear after these two lines of ungulates had been separated by an immense interval of time. In other words, upper Miocene variation was conditioned by the structure of a lower Eocene ancestral type.

This is the proper place to recall a kindred conception of Variation which has been in the minds of many, and has been clearly formulated it appears by Waagen. It is of Variation so inconspicuous and so slight that it can only be recognized as such when we place side by side two individuals separated by a long series of generations.[20] Mark the contrast with the extreme of St. Hilaire's saltatory evolution; or again, the contrast with Darwin's and Weismann's conception of Variations, not, it is true, of a saltatory character, but as sufficiently important and conspicuous to become factors in the survival of the organism. This conception of 'phylogenic variation,' as we have seen, is consistent with the application of Galton's principles to human evolution, but it finds its

[19] Rise of the Mammalia in North America. *Contr. Biol. Dept. Columbia College*, vol. I, No. 2, September, 1893.

[20] This was brought out by the writer in his Oxford paper. See *Nature*, August 30, 1894, p. 435. It has recently been independently stated with great clearness by Scott in his article Variations and Mutations. *American Journal of Science*, November, 1894. Scott, following Waagen, revives the terms 'mutation' for what Nägeli has termed 'phylogenic variation.'

strongest support in palæontology, and is the unconscious motive of dissent on the part of all palæontologists, so far as I know their opinions, independently working in all parts of the world, to the fortuitous Variation and Selection theory.

Our palæontological series are unique in being phyletic series. They exhibit no evidences of fortuity in the main lines of evolution. New structures arise by infinitesimal beginnings at definite points. In their first stages they have no 'utilitarian' or 'survival' value. They increase in size in successive generations until they reach a stage of usefulness. In many cases they first rise at points which have been in maximum use, thus appearing to support the kinetogenesis theory. In extensive fossil series we also find evidence of anomalous or neutral variations, such as Bateson has brought together, but these are aside from the main lines of evolution. They present no evidence for the Neo-Darwinian principle of the accumulation of adaptive variations out of the fortuitous play around a mean of adaptive and inadaptive characters, but they present strong evidence of the Darwinian principle of the survival of the fittest. The main trend of evolution is direct and definite throughout, according to certain unknown laws and not according to fortuity. This principle of progressive adaptation may be regarded as inductively established by careful studies of the evolution of the teeth and the skeleton. Its bearing upon Lamarck's factor of the transmission of somatogenic variation was pointed out by myself in 1889; it does not positively demonstrate Lamarck's factor because it leaves open the possible working of some other factor at present unknown, and Lamarck's factor is also inadequate; but it positively sets aside Darwin's factor as *universal* in the origin of adaptations and as a consequence 'the all-sufficiency of Natural Selection.' If Lamarck's factor is disproved, in other ways, it leaves us *in vacuo* so far as a working hypothesis is concerned.

The conclusions which Hyatt, Dall, Williams, Buckman, Lang, and Würtemberger have reached among invertebrates are independently paralleled by those of Cope, Ryder, Baur, Scott,[21] the writer, and many other morphologists. The same

[21] W. B. Scott: On Some of the Factors in the Evolution of the Mammalia. *Journ. of Morphology*, vol. V, 1891, p. 378.

general philosophical interpretation of evolution is now independently announced from an entirely different field of work by Driesch. We may waive our applications of these facts to theories, but let us not turn our backs to the facts themselves!

THE OUTLOOK FOR INDUCTION.

The problems I have described are the main ones. No longer misled by palingenic variation under revival of an ancient environment, let us set ourselves rigidly to the analysis and investigation of the responses of the organism to new environment, in all four stages of development. Are these responses adaptive? Is there a teleological mechanism in living matter as Pflüger[22] has expressed it? Is this mechanism in the adult reflected and accumulated in the germ?

One most hopeful outlook is in Experimental Evolution. Bacon in his *Nova Atlantis* three centuries ago projected an institute for such experiments, which when it finally materializes should be known as the Baconian Institute. The late Mr. Romanes proposed to establish such a station at Oxford, and went so far as to institute an important series of private experiments, which were unfortunately interrupted by his death. What we wish to ascertain is, whether new ontogenic variations become phylogenic, and how much time this requires.

The conditions of a crucial experiment may be stated as follows: An organism A, with an environment or habit A, is transferred to environment or habit B, and after one or more generations exhibits variations B; this organism is then retransferred to environment or habit A, and if it still exhibits, even for single generation, or transitorily, any of the variations B, the experiment is a demonstration of the inheritance of ontogenic variations. These are virtually the conditions rightly demanded by Neo-Darwinians for an absolute demonstration, either of Lamarck's or Buffon's principle of the inheritance of embryogenic or somatogenic variation but it is important to observe that such return to a former environment is very rare in a state of nature. There is no record that such

[22] Pflüger: Die teleologischen Mechanik der lebenden Natur. Bonn. 1877.

conditions have as yet been fulfilled, for hitherto organisms have been simply retained in a new environment, and the profound modifications which are exhibited may simply be the exponents of an hereditary mechanism acting under the influence of new forces. Such experiments will probably require an extended period of time, for we learn from palæontology, as well as from palingenic variation, that phylogenic inheritance is extremely slow in a state of nature.

It is desirable to establish non-infectious experimentation involving the conditions named above, mainly as a test of Lamarck's factor. Varigny has also proposed a crucial experimental series mainly upon Buffon's factor. His volume upon *Experimental Evolution* is an invaluable review, especially of French researches in experimental transformism. Much of this is in the line brought together some years ago by Semper in his *Animal Life.* Varigny draws a valid distinction between morphological variation and physiological variation, including under the latter internal chemical and constitutional differences which are not displayed in structure but must underlie all reactions. Under the head of what I have called Gonagenic Variation, the author discusses the work of Gautier[23] upon the influence of previous fertilization in plants as well as upon the chemistry of plants in connection with color variation. He adds to the observations of Yung and Born other studies upon sex determination. He describes the experimental teratogeny or embryonic variation of Dareste, Fallon, and later observers.

Throughout Varigny's volume it is nevertheless evident that none of the studies upon Ontogenic Variation hitherto have been specifically directed to the vital problem, as they must be in the future. Varigny makes a useful suggestion as to the importance of imitating natural conditions in experimental work, but he fails to emphasize the importance of the tests set forth above in order to ascertain whether the acquired modifications have actually been impressed upon the hered-

[23] Armand Gautier: Du Mécanisme de la Variation des Etres vivants. (Hommage à Monsieur Chevreul à l'Occasion de son Centennaire). F. Alcan. Paris, 1886.

itary mechanism or merely upon the various stages of ontogeny.

CONCLUSIONS.

The general conclusion we reach from a survey of the whole field is, that for Buffon's and Lamarck's factors we have no theory of Heredity, while the original Darwin factor, or Neo-Darwinism, offers an inadequate explanation of Evolution. If acquired variations are transmitted, there must be, therefore, some unknown principle in Heredity; if they are not transmitted, there must be some unknown factor in Evolution.

As regards Selection, we find more than the theoretical objections advanced by Spencer and others. Neo-Darwinism centers upon the principles of fortuitous variation, utility, and selection as universal. In complete fossil series it is demonstrated that these three principles, however important, are not universal. Certain new adaptive structures arise gradually, according to certain definite laws, and not by fortuity.

Lamarck's and Buffon's factors afford at present only a partial explanation of these definite phylogenic variations, even if the transmission of acquired variations be granted. Nägeli's factor of certain constitutional lines of variation finds considerable verification in fossil series as a principle of determinate variation, but not as a general internal perfecting tendency. St. Hilaire's factor of occasional saltatory evolution by sudden modification of the hereditary mechanism is established, but not as yet understood, although we are perhaps approaching an explanation through experimental embryology.

Our standpoint towards Variation in relation to all the Factors requires thorough reconsideration. The Darwinian law of Fortuity and the Buffon law of the direct action of Environment, have hitherto been inductions from variations which may be largely ontogenic and transitory. They both require confirmation on data of phylogenic variation. As for Lamarck's factor, the evidence seems to be conclusive that somatogenic variation is largely adaptive; but it remains to be proved that phylogenic variations as observed in human anatomy and in palæontology are invariably anticipated by corresponding

changes in the individual, in other words, that the definite current of variation is guided by the inheritance of individual reactions and not by some other principle.

Another consideration is, that individual Variation may play a far less conspicuous rôle than we have assigned to it; in other words, that many of the most important changes in successive generations are so gradual as to be entirely inconspicuous in a single generation.

Our conception of the mechanism or physical basis of Heredity is also to be made much clearer by a series of experiments directed to palingenic variation, in order to ascertain how far the revival of an ancient environment arouses latent hereditary forces. The experiments already well advanced by Cunningham, Agassiz, and Poulton indicate that *progressive inheritance is rather a process of substitution of certain characters and potentialities than the actual elimination implied by Weismann.*

My last word is, that we are entering the threshold of the Evolution problem, instead of standing within the portals. The hardest tasks lie before us, not behind us, and their solution will carry us well into the twentieth century.

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ON THE PRESENCE OF FLUORINE AS A TEST FOR THE FOSSILIZATION OF ANIMAL BONES.

By Dr. Thomas Wilson.

(*Continued from page 317, Vol. XXIX.*)

It is interesting to examine closely this question, and, for that purpose, critical analyses have been made of a large number of bones of different geological ages. The fluorine and phosphoric acid have been determined with exactitude and the proportion of the quantity of fluorine found in the bones to that which apatite, having an equal quantity of phosphorus would contain, has been calculated. The calculation of the fluorine of apatite is easily made by multiplying the weight of the phosphoric acid by the co-efficient 0.0892 which expresses the normal proportion $\frac{2Fl}{3P_2O_5}$

The following series of analyses of bones are arranged in chronological order of the geological formations to which they belong, commencing with the more recent deposits and descending step by step to the most ancient. (The French nomenclature is employed.)

Analyses of bones of fossil animals from various Geologic Epochs or Periods.

Quaternary.	Organic matter.	Ash				Ratio.
		Oxide of iron.	Phosphoric acid.	Fluorine.	Fluorine of apatite.	
1. Rib of a Reindeer from Montreuil (Seine), orange color passing to a bluish green by calcination. *Gain* or *increase* of carbonate of lime, slightly of chlorine, none of silica........	16,40	1,45	36,95	1,07	3,30	0,32
2. Horn of Reindeer from the same place, orange-yellowish, reddened by ignition. Gain or increase of carbonate of lime, slight chlorine and silica........	19,60	4,35	37,35	0,78	3,33	0,23
3. Tooth of Mammoth (*Elephas primgenius*) from the gray diluvium of Grenelle (Seine). White, slightly yellowish. An abundance of carbonate of lime........	....	....	30,60	1,16	2,73	0,42
4. Vertebra of an Ox from Cindre (Allier). Yellowish white becoming bluish by calcination........	17,9	0,71	37,19	0,83	2,32	0,25
5. Rib of a *Glyptodon* from the Pampas of Buenos Ayres (Argentine Republic), of average density; yellowish before and after calcination. *Increase* of carbonate of lime, chlorine in normal quantity with little silica........	22,60	....	27,38	1,77	2,44	0,73
6. Shell of *Glyptodon* from same locality and with same characteristics........	14,90	....	28,41	1,55	2,53	0,61
7. Mylodon, *Os dermiques d'edente*—bones of the skin or shell with tooth-like edges, from the same locality; gray-yellow, becoming gray-green by calcination. Increase of carbonate of lime, traces of chlorine, no silica........	13,14	0,95	36,32	1,43	3,24	0,44
8. Rhinoceros teeth from the Cave of Grimaldi, Italy. These were in a good state. The dentine (a) which separates easily from the enamel, was fragile, white, slightly yellow, with a gain of carbonate of lime........	10,72	0,40	36,95	1,32	3,30	0,40
The ivory (b) was entirely white and conserved its compactness and hardness—does not appear to have been modified in its texture nor primitive composition....	5,32	....	40,34	0,50	3,60	0,14
9. Lamantin (Manatee or Sea Cow). Bones from the peat beds of Scania, Sweden. Light, very porous, black-brown passing to dark-brown by calcination........	33,40	5,10	35,77	0,44	3,19	0,14
10. Man, pelvic bone from *l'Abri-sous-Ro he* of Cro-Magnon (Dordogne). Light, porous, reddish in color, becoming gray-white by calcination. A gain of carbonate of line, traces of chlorine, no silica........	27,50	1,80	34.48	0,52	3,08	0,17

By grouping the results of the determinations of phosphoric acid and of fluorine, the average for the ten specimens from the Quaternary Period is established.

Phosphoric acid, ...	34.14	
Fluorine, ...	1.09	Ratio, 0.36.
Fluorine calculated for apatite, . .	3.04	

Pliocene.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Halitherium.* Bone from the deposit of Gourbesville (Manche). Dense, color blackish, becoming gray by calcination	11,82	......	30,40	2.51	2.71	0.93
2. *Elephas meridionalis,* from Durfort (Gard). Reddish-gray, becoming blue-green by calcination. Slight gain of carbonate of lime, little of chlorine, with slight of sand	16,30	......	36,84	0.88	3.29	0.27
3. *Elephas meridionalis.* Tusk from the Saint-Prest (Eure-et-Loire), from the Geologic stage of Falunien	......	......	38,40	2 11	3.42	0.62

Average of the three Pliocene samples:

Phosphoric acid, ...	35.21	
Fluorine, ...	1.83	Ratio, 0.58.
Fluorine calculed for apatite, . .	3.14	

Miocene.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Dinotherium.* Tusk from the Orleans sands (*langhien* stage). Dense, dirty-gray, becoming blue-green clouded by ignition. Gain of carbonate of lime, neither chlorine nor sulphate	6.80	1.50	38.07	2.66	3.40	0.78
2. Mastodon tusk from the deposit of Sansan (Department of Gers). Langhien stage. When broken showed white with brown veins, becoming bluish by calcination. Gain of carbonate of lime but no chlorine, no silica	7,50	0.85	36.40	2.59	3.25	0.80
3. Mastodon, tusk very compact, gray chestnut color becoming gray with a light blue tint after calcination	......	0 75	39.80	2.36	3.55	0 66
4. *Rhinoceros brachypus.* Tibia from the calcaire of Simorre (*langhien* stage). Orange color, passing to reddish-brown by calcination. Gain of carbonate of lime, chlorine in normal quantity, a little silica	9.65	......	34.73	2.80	3.10	0.90
5. Gazelle horn from the tortonien deposit of Mont-Leberon (Department of Vaucluse). Yellowish-white, becoming bluish by ignition. Much carbonate of lime, traces of chlorine, no silica	6.70	1.93	15.54	0.78	1.38	0.57
6. *Hipparion.* Radius from the same deposit as No. 5. Yellowish-white which changes not by calcination. Slight gain of carbonate of lime, traces of chlorine	7.54	0.96	37.90	0.90	3.38	0 27
7. *Hipparion* from Pikermi (Greece). Yellowish-white, persisting after ignition; carbonate of lime abundant	8.54	0.90	34.26	0.93	3.06	0.31

Average of the seven Miocene specimens:

Phosphoric acid, ...	33.81	
Fluorine, ...	1.86	Ratio, 0.61.
Fluorine calculated for apatite, . .	3.02	

Oligocène.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Halitherium schinzi* from the tongrien sands of d'Etrechy (Department of Seine-et-Oise). Dense, yellow-orange, becoming reddish-brown by calcination. Carbonate of lime and chlorine in normal quantities, little silica	9.30	4.60	36.65	1.86	3.27	0.57
2. *Halitherium schinzi* from the tongrien deposit of d'Etang-la-ville (Department of Seine-et-Oise). Dense, when fractured shows brilliant dark chestnut, its powder becomes gray and remains the same after calcination. Carbonate of lime in normal quantity, traces of chlorine, little silica	8.31	2.20	36.70	3.26	3.27	1.00
3. Ruminant. Bone from the deposit of Auvergne. Grayish-white, average density with a slightly blue tint by calcination. Carbonate of lime and chlorine in normal quantities, no silica	7.83	....	38.80	2.46	3.46	0.71
4. Rhinoceros. Bone from the deposit of phosphorites of Quercy. The exterior zone is hard and compact, violet and white mixed; with an interior zone, porous, red, with white crystals of carbonate of lime. The exterior zone only was analyzed. The powder was gray and took a bluish tint by calcination. Carbonate of lime abundant. Traces of chlorine, no silica	5.90	1.80	35.08	0.62	3.12	0.20

Average of the four samples from the Oligocene:

Phosphoric acid, ... 38.81

Fluorine, ... 2.05 } Ratio, 0.59.

Fluorine calculated for apatite, . . 3.46 }

Eocene.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Flourine.	Ash: Fluorine of apatite.	Ratio.
1. *Paloplotherium codiciense.* Pelvic bone from the calcaire of Jumencourt (Department of Aisne). Light, easy to pulverize, brownish, becoming a gray yellowish with bluish tint by ignition. Carbonate of lime abundant, but little chlorine and little silica	13.06	0.70	31.10	2.45	2.77	0.88
2. Crocodile—Lower Eocene. Bone of the head. Dense, black-brown, becoming reddish-brown by ignition. Notable quantity of pyrites of iron, carbonate and sulphate of lime with traces of chlorine	10.30	6.50	30.03	1.40	2.68	0.52
3. *Anoplotherium commune.* Metacarpal from la Debruge (Department of Vaucluse). Dense, fracture showing mat, with a blackish brown, studded with white crystals and brilliants of carbonate of lime. Is easily powdered when it becomes gray-chestnut, and by ignition passes to a gray-white	11.72	0.66	29.09	1.98	2.59	0.76
4. *Palæotherium magnum.* Cubitus from the gypsum of Villette (Paris). Porous, fracture shows a yellow color; after ignition the powder becomes greenish-white. A gain of carbonate of lime, a little sulphate with traces of chlorine	8.67	0.80	33.70	2.05	3.01	0.68
5. Turtle. Shell from the gypsum of Paris (the lower stage ligurien). Light, porous, orange color, becoming white by ignition. Gain of carbonate of lime, notable quantity of sulphate, traces of chlorine and no silica	7.80	0.90	27.26	1.64	2.43	0.67

Average of the five specimens from Eocene:

Phosphoric acid, ...	30.39	
Fluorine, ...	1.90	Ratio, 0.70.
Fluorine calculated for apatite, . .	2.71	

Cretaceous.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Mosasaurus camperi.* A vertebra from the chalk of Maestricht, Belgium. Porous, a grayish-brown, becoming slightly green by calcination. Carbonate of lime in large quantities, traces of chlorine, no silica......	10.18	2.50	32.73	3.06	2.92	1.05
2. Large turtle from the same locality with the same characters. The colors slightly more reddish.................	8.69	4.10	36.10	3.33	3.22	1.03
3. Reptile *dinosaur* from the superior cretaceous of Ariege. White, dense, becoming green or greenish by calcination. Carbonate of lime in considerable quantity, traces of chlorine, no silica..........................	7.53	0.47	32.70	2.85	2.92	0.98
4. *Iguanodon*—wealdien of Bernissart, Belgium. Black, dense, fragile; giving a powder of light gray, turning slightly yellow, but becoming clear gray with light green tint by ignition. Carbonate of lime in rather large quantity, sulphate of lime in notable quantity, no pyrites, a little silica, traces of chlorine.............	6.47	2.37	32 17	2.62	2.87	0.91
5. Reptile *dinosaur.* Rib from the wealdien stage of Filgate, Southern England. Porous, brownish-gray, becoming chestnut gray by ignition. Carbonate of lime in about normal quantity, traces of chlorine, no silica..	8.80	3.30	38.65	2.76	3.45	0.80
6. Reptile *dinosaur* of the wealdien of Lewes, Southern England. Reddish-chestnut, becoming a dirty gray with a light blue tint by ignition. Carbonate of lime in normal quantity, a little silica, traces of chlorine, absence of sulphate of lime and pyrites....................	9.20	3.18	36.32	2.59	3.18	0.80

Average of the six Cretaceous specimens:

Phosphoric acid, ...	34.92	
Fluorine, ...	2.87	Ratio, 0.92.
Fluorine calculated for apatite, . .	3.11	

Jurassic.	Organic matter.	Ash: Oxide of iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Flourine of apatite.	Ratio.
A. Oolithic.						
1. *Ichthyosaurus.* Vertebra from the kimmeridigian clays of Havre. Dense, black, fracture mat, with much carbonate of lime crystallized, a little sulphate of lime, iron pyrites, a little silica and clay....................	17.25	0.68	6.40	0.56	0.57	0.98
2. *Teleosaurus cadomensis.* Bony escutcheon from the grand oolithic deposit (bathonien) of Caen (Department of Calvados). Dense, brownish-gray, passing to grayish yellow by calcination. Carbonate of lime and sulphate of lime in notable quantities, a little clay, traces of chlorine....................	7.30	0.90	34.97	2.31	3.12	0.74
3. *Pholidophorus.* From the lithographic calcaire of Cerin (Department of Yonne). Imprints of fishes. A reddish-yellow, passing by ignition into a rose color, lightly tinted with yellow and green. Carbonate of lime in notable quantity, traces of chlorine, no silica......	11.62	1.05	33.94	1.89	3.03	0.62
B. Lias.						
4. *Ichthyosaurus burgundiæ.* Vertebra from the superior lias of Saint Colombe, (Department of Yonne). Dirty gray, with slightly yellowish, remaining same color after ignition. Lamellar texture due to the abundance of carbonate of lime *spathique*, traces of chlorine, a little pyrites, absence of silica and sulphate of lime......	6.78	2.47	12.93	1.38	1.15	1.20
5. *Ichthyosaurus.* Vertebra from the middle lias of Calvados. Dense, chestnut mixed with white, strewed with crystals of carbonate of lime; breaks and pulverizes easily; it is broken down in the fire and it becomes yellowish-orange with traces of green; much carbonate of lime, a little silica, ferruginous clay of sulphate of lime, no pyrites, chlorine in normal quantity....................	8.85	2.30	11.04	0.96	0.98	0.98
6. *Teleosaurus* of lias. Dense, reddish-brown, becoming yellowish-gray, with bluish portions by ignition; much carbonate of lime, a little silica and clay, absence of sulphate of lime and pyrites of iron, chlorine normal...	13.38	4.65	10.57	0.86	0.94	0.91
7. *Plesiosaurus.* Vertebra of the lower lias of Vievry, near Igornay, Department of Saone-et-Loire. Orange, slightly gray, passing to a blackish-gray by ignition. Fibrous texture, semi-crystalline, by abundance of carbonate of lime, more than the average quantity of chlorine, a little silica....................	15.24	2.73	14.79	2.19	1.31	1.67

Average of the seven Jurassic specimens:

Phosphoric acid, ...	17.79	
Fluorine, ...	1.44	Ratio, 0.91.
Fluorine calculated for apatite, . .	1.58	

Triassic.	Organic matter.	Ash: Oxide of Iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Simosaurus.* Femur from muschelkalk of Bayreuth in Bavaria. Orange-yellow, becoming greenish-yellow by ignition. Carbonate of lime in considerable quantity; chlorine normal, no silica	11.92	2.41	19.64	1.40	1.75	0.80
2. Reptile from muschelkalk of Moselle. Light brown, becoming gray after ignition. Gain of carbonate of lime, very little magnesia and chlorine, and a little ferruginous clay	16.28	1.75	24.23	2.07	2.16	0.96

Average of the two Triassic specimens:

Phosphoric acid, ... 21.93

Fluorine, ... 1.74 } Ratio, 0.89.

Fluorine calculated for apatite, . . 1.95 }

Permo-Carboniferous.	Organic matter.	Ash: Oxide of Iron.	Ash: Phosphoric acid.	Ash: Fluorine.	Ash: Fluorine of apatite.	Ratio.
1. *Pleuracanthus frossardi.* Cartilaginous fish from Thelots near Autun (Department of Seine-et-Loire). A hard and black imprint on schist. The detached fragment gives a dark chestnut powder, becoming bluish-gray by ignition. Phosphate of iron, a little carbonate of lime, a little chlorure soluble in water, abundant residue insoluble in the acid	34.55	3.18	22.57	2.26	2.01	1.17
2. *Palaeoniscus.* Ganoide fish from Muse near Autun. Brilliant scales of a brownish-gray, becoming reddish-brown by ignition. Much iron, considerable quantity of chlorine, no carbonate of lime, insoluble residue abundant	22.27	6.70	26.20	1.55	2.33	0.67
3. *Actinodon frossardi.* A reptile labyrinthodonte from Felots near Autun. The same characteristics as No. 1	29.66	2.08	28.35	3.62	2.53	1.43
4. *Haptodus baylei.* Of the same origin and same characteristics	42.52	2.37	28.23	3.15	2.52	1.25
5. *Archegosaurus.* From Lebach near Saarbruck. A black imprint, tender, chestnut powder becoming a brownish-red by ignition. Absence of carbonate of lime and of chlorure, notable quantity of sulphate of lime and a little pyrites of iron. Insoluble residue quite abundant	6.07	6.73	28.37	2.02	2.53	0.80

Average of the five Permian specimens:

Phosphoric acid, ... 26.74

Fluorine, ... 2.54 } Ratio, 1.06.

Fluorine calculated for apatite, . . 2.38 }

Devonian.

1. *Asterolepis* Bony plates from the Devonian of Livonia, Russia. Dense, brownish-black, becoming reddish-gray by ignition. Very little carbonate of lime, notable quantity of quartz with traces of chlorine.

Organic matter, ...	5.20	
Ash: Oxide of iron, ...	3.02	
Phosphoric acid,. . . .	29.50	
Fluorine, ...	2.59	Ratio, 0.98.
Fluorine of apatite, . . .	2.63	

Silurian.

The debris of fish extracted from a ferruginous bone breccia of the inferior silurian of Canyon City, Colorado, U. S. A., reported in 1891 by Mons. Albert Gaudry, after his journey to the Rocky Mountains.

Organic matter, ...	5.67	
Ash: Oxide of iron, ...	7.47	
Phosphoric acid, . . .	32.63	
Fluorine, ...	2.72	Ratio, 0.94.
Fluorine of apatite, . . .	2.90	

General observations.—Bones of the same age present great differences in their composition; but one can, nevertheless, conclude from the foregoing series of analyses, in a general fashion, that the fossilization is accompanied by an important increase in the proportion of carbonate of lime, of oxide of iron and fluorine.

For the first two of these elements, the augmentation is too irregular, too usually affected by special influences of the deposit where they were buried, to enable us to indicate with certainty the true fossil state of the bone. We frequently observe, also, a high proportion of carbonate of lime and of oxide of iron in bones which have been buried for a time, either longer or shorter, but which, after all, belong to the modern period.

It is otherwise for the fluorine, and in spite of the great variations in the proportions of this mineral remarked in the bones of the same period belonging to deposits in different localities, it does appear that we may formulate a general law of age based upon the increase in the proportion of fluorine existing in them. This law is shown with greater certainty and clearness in the comparison of the average proportions in the entire number of specimens from each geologic epoch than from the proportions in the individual specimens, and in order to render this more apparent, the table following of geologic epochs shows the average results obtained from the bones of each one of these periods. The first column gives the average proportion (as above calculated) of fluorine to that of an apatite containing the same quantity of phosphoric acid. The second column gives the average ratios of the weight of phosphoric acid to the weight of fluorine.

Geologic Periods.	The ratio between the quantity of fluorine in the bone, to that of apatite.		The ratio of the weight of phosphoric acid in the bone to that of fluorine.	
Modern	0.058	0.058	193.1	193.1
Quaternary	0.36	0.360	31.3	31.30
Tertiary				
pliocene	0.58	0.620	19.2	18.15
miocene	0.61		18.3	
oligocene	0.59		18.9	
eocene	0.70		16.0	
Secondary.				
cretaceous	0.92	0.907	12.2	12.40
jurassic	0.91		12.3	
triassic	0.89		12.6	
Primary.				
permo-carboniferous	1.06	0.993	10.5	11.30
devonian	0.98		11.4	
silurian	0.94		12.0	
Apatite normal	1.00	1.000	11.21	11.21

The averages set forth in the figures of this table are not to be taken as of absolute, but only as of relative, value. The only ones which can be considered definite are those relative to apatite on the one side and to the modern bones on the other. For the fossil bones, the average not only varied with

the choice and number of the specimens analyzed, but the specimens taken for analysis were varied as much as possible and in sufficient number as to leave no doubt as to the correctness of the final result. There is a progressive increase in the quantity of fluorine as compared with the quantity of phosphoric acid, between the bones of modern times and those of quaternary times; and that the latter contain, on the average, six or seven times more than do the bones from the tertiary, secondary or primary epochs.

The tertiary bones contain, on the average, eleven times more fluorine than the modern bones, and this augmentation appears gradually from one geological period to another.

The bones belonging to the secondary epoch have a proportion of fluorine sixteen times more, and those of the primary, eighteen times more than the modern bones.

The bones of the most ancient epochs have almost exactly the same proportion of crystallized apatite; the secondary bones are not far behind, but the loss becomes sensible in the tertiary bones, and more so in the quaternary bones. The contrast is still more striking in modern or recent bones, where the fluorine is found in a minimum proportion.

Causes of the increase of Fluorine in Fossil Bones.—What can be the cause of this progressive enrichment of fossil bones in fluorine? How can one explain that this increase has for a general limit the proportion of fluorine in apatite, although this limit is sometimes exceeded? It seems proper to say "increase of proportion of fluorine," as we could not admit for an instant that the bones of ancient animals contained during their life the proportions of fluorine which we now find in them. Even if this were not opposed to known physiological law, it would still become necessary to reject the theory because of the considerable difference observed in the composition of bones coming from the same species, whether from the same or from different epochs. The question arises—what could have been the vehicle of the fluorine? We can only think of gas or liquid, i. e., of something belonging to atmosphere or water. But as we have no knowledge of any chemical condition of fluorine under which it could be carried in a

gaseous state in a humid atmosphere in the sedimentary strata, we are obliged to conclude that it penetrated into these strata under the form of an aqueous solution. It is, therefore, to infiltration of water, that has, during the lapse of time, come in contact with these fossil bones, that we must attribute this increase of fluorine, as well as other chemical changes, like the fixation of oxide of iron, the fixation and more rarely the disappearance of carbonate of lime, the solution of phosphate, etc. According to all appearance, the infiltrating water carries traces of fluorine in solution, and these traces have been fixed progressively on the phosphate of lime, by virtue of some sort of affinity which we may suspect, remarking that all crystallized phosphates of lime contain fluorine (or chlorine) in a constant quantity. But there are other proofs—the affinity of the phosphate of lime for fluoride or for chloride of calcium at a high temperature has been demonstrated by the experiments made in connection with the synthesis of apatite, which synthesis was made first by Mons. D'Aubrée (by means of lime and chloride of phosphorus), then by Forschammer (by phosphate of lime and chloride of sodium), then by H. Sainte Claire Deville and Caron (by phosphate of lime and chloride of calcium).

Experiments have been made to determine whether the same affinity was sensible in the cold and by the wet way; and if the phosphate of lime in modern bones could fix the fluoride of calcium in analogous conditions with those in which the fossil bones must have been (save and except the lapse of time and the degree of concentration of the liquids).

Experiment No. 1.—A bone of a manatee (in fragments) was placed in 200 cubic centimetres of a solution of alkaline fluoride diluted to the 50th part, containing 2 grams of carbonate of ammonia. At intervals of time, longer or shorter, fragments of this bone were taken out, carefully washed and dried and subjected to analysis for fluorine. The proportion of bone in the fluorine was originally $\frac{31}{100}$ of one per cent. After remaining fifteen days in this solution, had increased to 1.70 per cent. After remaining a month in the liquid, it contained 2.81 per cent, and after five months, 7.74 per cent. The pro-

portion, however, of phosphoric acid had, on the contrary, been reduced from 38.93 to 35.06. There had been a formation of fluoride of calcium at the expense of the original phosphate of lime and carbonate of lime, and a mixture which contained more fluorine than apatite had been formed; for the latter would have contained only 3.13 of fluorine instead of 4.74.

Experiments 2 and 3.—Two analogous experiments were made with solutions of chloride in which were placed the fragments of the bones of the manatee containing at the beginning $\frac{16}{100}$ of one per cent of chlorine in the form of an insoluble compound. After remaining for three months in a solution of one tenth of chloride of sodium, we showed $\frac{16}{100}$ of one per cent (0.16) of insoluble chlorine. After three months in solution of one-twentieth of chloride of sodium and one-twentieth of chloride of calcium, the bones contained 0.24 per cent of chlorine in an insoluble state. Therefore, there had not been any fixation of chlorine by the action of chloride of sodium alone on the phosphate of lime, but it was by the action of chloride of calcium; the proportion of chlorophosphate formed was otherwise much less than that of fluophosphate produced by a solution, even very feeble, of an alkaline-fluoride. We can conclude that the affinity of phosphate of lime is much greater for the fluoride than for the chloride.

Experiment No. 4.—In other experiments, instead of using an alkaline-fluoride easily soluble in water, there was employed fluorspar in fine powder, to which was added distilled water, with a little carbonate of ammonia, a salt which frequently forms near, on, or in the bone by reason of the decomposition of organic matter, and which can aid in the solution of a small quantity of fluoride of calcium.

The fragments of the bones of the manatee were placed in an uncovered vessel with sand, with 200 cubic centimetres of distilled water and 2 grams of carbonate of ammonia, and it was noticed that the proportion of fluorine which, at the beginning, was 0.31 per cent, became 0.35 at the end of the month and 0.43 at the end of three months. While the bones were thus immersed, the solution was frequently shaken and

distilled water added to replace loss by evaporation. There was, under these conditions, a notable increase in the bones, of fluoride of calcium, despite the slight solubility of the fluorspar employed as a re-agent. We then have the right to suppose that the continuous action during an indefinite time could produce a fluoration much more advanced than that shown in the experiment. The analyses or attempts did not succeed the same in closed vases where the bones were in the presence of the powder of fluorspar and of carbonate of ammonia of 2 grams, whether with seltzer water only, or with the seltzer water and sand. After three months of trial, one of the bones showed 0.32 and the other 0.31 of fluorine.

The experiment was also made of the action of a copper-zinc couple in the mixture; but at the end of four months this contained still 0.30 per cent of fluorine, about the same as at the begininng. From these negative results we may make certain inductions which may be of utility in explaining the phenomena.

There was realized in experiments 1 and 4 the gradual fixation of fluoride of calcium on the phosphate of lime of the bones, whether using fluoride of calcium in powder (of which a small proportion was dissolved in the water containing carbonate of ammonia), or whether in producing action upon the bones by a small quantity of alkaline fluoride in solution. The alkaline fluoride can act directly upon the phosphate of lime in giving birth to fluoride of calcium and to a soluble alkaline phosphate, from which results a diminution of the proportion of the insoluble residue of phosphoric acid; or it can produce action of the alkaline fluoride on the carbonate of lime which is found mixed with phosphate in the bone and which causes the formation of fluoride of calcium.

In cases where the fluoration takes place under the sole influence of fluoride of calcium, it ought to have for its extreme limit, the proportion which we observe in apatite—that is, about one part of fluorine to 11 parts of phosphoric acid. But if the alkaline fluoride intervenes, the fluoration can go farther and reach a proportion much higher than that of apatite. This was shown in Experiment No. 1, and it has been observed in fossil bones and in phosphates of organic origin.

Among the preceding analyses to be especially mentioned are those of three bones from the Permian of Autun (*Pleuracanthus*, *Actinodon* and *Haptodus*) those of two bones from the Lias of Igornay and of Saint Colombe (*Plesiosaurus* and *Ichthyosaurus*), the two bones from chalk of Maestricht (*Mosasaurus* and large turtle). The same effect was remarked by M. Phipson before the Acadamie des Sciences, Oct. 3, 1892. It is, therefore, not rare to meet with proportions of fluorine greater than that of apatite for the same quantity of phosphorus.

In some of the experiments heretofore given the proportion of fluorine, compared to that of apatite, which is taken for the unit, was increased from 1.03 to 1.67. The excess of fluoride of calcium can be attributed to the action of the alkaline fluoride in the solution, alone or mixed with fluoride of calcium, while the latter has perhaps alone produced the metamorphoses of the bones in which the proportion of fluorine does not exceed or perhaps has not even attained that of apatite.

In every point of view, in order to explain the fluoration of bone, there is admitted the existence of fluorine in solution in the waters which come in contact with these bones; at least this is the most plausible supposition, for, on the one hand, the fluorides and in particular the fluoride of calcium is sufficiently prevalent, not only in the crystalline rocks, notably in the masses of granite and granulite, but also in a certain number of sedimentary rocks, for example, coal-bearing strata in arkoses of Burgundy, in the *muschelkalk*, even in the *calcaire* of Paris, which appear to sufficiently indicate that waters charged with fluoride of calcium can circulate throughout these deposits; and on the other part, the fluoride of calcium not being completely insoluble, the infiltrated water, either more or less charged with carbonic acid, and with alkaline salts and salts of ammonia, could take it up from the rocks through which the water traversed and which are more or less impregnated with fluorine.

Many analyses of various waters reveal the existence of fluorides in solution even though in minute quantities. Nicklès found it in the waters of the Seine at Paris, of the Somme at

Ameins, of the Rhine at Strasbourg, and of the mineral waters of Plombières, Contrexville, Antogast, Chatenois, Vichy (Compte Rendus, 1857, Vol. I, page 783; Vol. II, pages 250 and 331). Also by Charles Mène in the waters of the Rhone, Saone, Loire; by Rose in the well-waters of the neighborhood of Berlin (Compte Rendus, 1860, Vol. I, page 731); in the waters of Plombières by Jutier and Lefort (9 or 10 millegrams per litre); Carlsbad by Berzelius (3 mg, 2); Kreusbrunnen by Berzelius (traces); Kissingen and Aix-la-Chapelle by Leibig (traces); d'Orezza by Poggiale, the latter ones cited in the Dictionaire de Chimie by Wurtz, Vol. II, page 1206.

Clemm and Forchhammer recognized in the deposits formed by the evaporation of sea water, phosphate of lime accompanied by carbonate and fluoride (Daubrée, Gisements de chaux phosphatée, Annales de Mines, 1868, page 81.)

The existence of fluorides has been also discovered in different substances, both animal and vegetable, as blood, milk, urine, yellow of the egg (Nicklès, Compte Rendus, 1857, Vol. II, page 331; Tamman, Zeitschrift f. physiolog. Chimie, 1888, page 322).

And finally, this substance is much more extensively diffused than has been generally believed. There is, therefore, nothing astonishing that the infiltrated waters which come in contact with animal bones should contain in small quantities the fluorides in solution, and should produce, in the course of a long period of time, a sensible modification in the composition of those bones; but which must have been affected with extreme slowness because of the very feeble proportion of fluorides in solution. Ordinarily the traces are so minute that it is extremely difficult to recognize them by analysis, and it must have taken a great number of centuries for the variation in the proportion of fluorine to become appreciable. The other changes in the nature of bones are often much more rapid and more irregular. An augmentation of several hundredths in the proportion of oxide of iron can be produced in a short interval of time. It is the same with a notable variation in the proportions of phosphate and carbonate of lime; while, as for the silica, sulphate of lime, pyrites

of iron, they are encountered only in an accidental manner. The different modifications in the chemical composition of bones, depend essentially upon the nature of the filtrating water and by consequence with that of the strata which they percolate.

It is the same as to the proportion of organic matters which diminish with time, but in a very irregular fashion according as the earth is more or less permeable. There is even to be found, sometimes, considerable organic matter in bones of great antiquity. The differences are too great between one deposit and another for us to be able in general to draw from the presence or the proportion of these elements, any induction as to the length of time the bones have remained in the earth.

The fixation of fluorine upon the phosphate of the bones is subordinate in a certain measure to the conditions of the deposits and surrounding earth. The local circumstances have probably a much less influence because of the slowness of the phenomena. In any case, the series of analyses which are here given, show clearly that the proportion of fluorine increases at a perceptible rate during the later geological periods, and that it can furnish in consequence better than the other elements a characteristic indication of the antiquity of the bone.

The following conclusions seem to be justifiable. In the different deposits of the primary and secondary geologic epochs, the relative proportions of fluorine and of phosphoric acid are, upon the average, about the same as in crystallized apatite. In the tertiary and quarternary deposits there is a progressive and marked decrease in the proportion of fluorine, but this proportion remains during these epochs much higher than in modern times. It will, perhaps, be possible to use this means to fix the veritable age of certain human bones which have been found in the neighborhood of quaternary animals, but the deposits of which may have been disturbed and the bones mixed. We cannot at present, from these experiments, establish this as a general method for the determination, accurate or absolute, of the degree of antiquity of

human bones in all deposits, for the different chemical compositions of the deposits may produce differences in the composition of the bones which will neutralize all our efforts in this direction.

The incident at Billancourt affords an excellent illustration. Mons. Rivière, of Paris, sent to Mons. Carnot at the Ecole des Mines, two fragments of animal bones and one human tibia to be submitted to analysis (Bull. Soc. Anthrop., Paris: No. 6, 15 July, 1893, Vol. 4, 4th Serie, page 309). The animal bones were white, friable and quite dense; the human tibia was brownish-yellow, light and soft enough to crush under reasonable pressure. The ignition showed the following: In the animal bones, the organic matter was from 12.93 to 12.69; with the human tibia it was 19.65, and, therefore, the decomposition of the latter was much less than that of the first. The ash of the animal bone was a greenish-white; of the human, a bluish-gray attributable probably to phosphate of iron. The determination of peroxide of iron gave in effect 0.19 to 0.21 for the animal bone, and 3.06 for the human tibia. This difference gives a presumption against the age of the two sets of bones being the same. The proportions of carbonate of lime differed slightly; for carbonic acid, the animal bones gave from 6.06 to 4.75, while it was 6.15 in the human tibia. The determination of the phosphoric acid and fluorine were as follows:

	Fossil animal. Long bones.	Fossil animal. Scapula.	Modern? Human Tibia.
Phosphoric acid	34,30	35,67	28,72
Fluorine	1,43	1,84	0,17

The phosphoric acid, then, had diminished more in the human bones than in the animal as though the latter had been more ancient. But the relationship between the phosphoric acid and the fluorine is found as follows in the three cases:

	23,9	19,4	168,9

As has been established in the table on page 447, the relation between the weight of the phosphoric acid and the weight of fluorine and water was in the neighborhood of 193 in modern bones, while it became reduced to 31 in the average of quaternary bones, and 19 for their average in bones of the pliocene period. Therefore, the animal bones found in the sands of Billancourt present a relative proportion of fluorine intermediate between the average of the quaternary bones and those of the pliocene, that is to say, for the one was 23.9, for the other, 19.4.

On the contrary, for the human tibia submitted to analysis, the relation is raised to 168.9 and it is, therefore, 8 times greater than in the animal bones, and is only slightly lower than that of the modern bones. We can, therefore, conclude that the human bone belongs to an age much more recent than those of the animal, and that if it was really in the ancient gravels of the Seine in the neighborhood of the found bones of the quaternary animal, it was only by reason of a natural change of position or else the result of accident.

It is believed that this new method of control may prove to be of utility in determining the problems relative to the antiquity of man. It often happens that in the excavations made in prehistoric stations, one encounters human bones associated with animal bones, whether in alluvial deposits, caverns or rock-shelters. If the man and the animal in these deposits were contemporaneous, their bones, having been exposed to the same influence and submitted to the same transformation, ought to have approximately the same proportion of phosphoric acid and fluorine. But if the human bones are of an age much more recent than those of the animal and have been introduced either by accident or fraud, we can, perhaps, find the proof by this chemical analysis and be able to detect the error by the difference in the relative proportions between their phosphoric acid and fluorine.

(*To be Continued.*)

THE GENERA OF BRANCHIOSTOMIDAE.

By Theodore Gill.

The work of Mr. Arthur Willey on "Amphioxus and the Ancestry of the Vertebrates" (N. Y., 1894) is a useful compilation of what is known respecting the general anatomical characteristics of the Branchiostomids, but much remains to be yet made known regarding structural details and the range of variation, not only within the family, but also within specific limits. A first step toward the proper examination of such variations is to segregate the species into groups distinguished by positive structural peculiarities or associations of characters. For the expression of such structural peculiarities, generic diagnoses and terms are the best expedients, and they will differentiate most clearly characters of secondary importance from those of tertiary rank and the common or family characters or those of primary rank. Unfortunately, Mr. Willey has not distinguished between the various grades of characters, but has thrown all the representatives of the family into one genus without any sectional subdivision and (adapting the sequence of Dr. E. A. Andrews), has interposed "*B. cultellum*" between "*B. caribæum*" and "*B. bassanum*," and even (unlike Dr. Andrews) added to the genus the *Asymmetron lucayanum* of Andrews. There appear to me, however, to be at least three well-marked genera. These are *Branchiostoma*, *Epigonichthys* and *Asymmetron*. Another (*Paramphioxus*) has been proposed by Prof. Haeckel (1893) for the "*Branchiostoma bassanum*" of Günther, and it is gratifying to find that my views seem to be in accord with that eminent master of discrimination and valuation of morphological characters and their expression in diagnostic form. Doubtless Prof. Haeckel has good reasons for the genus *Paramphioxus*, but he has not yet formulated its characters, although he has indicated that it has unilateral gonads, and, such being the case, it must be related to *Epigonichthys*, although apparently distinguished from it by difference in the relative development of the fins. A fifth genus is

apparently represented by the *B. pelagicum* of Günther, which may be named *Amphioxides.* The principal distinctive characters of generic importance appear to be the development of the gonads in two lateral rows or their restriction to one (right) side, the extent of the metapleural folds, the presence or want of what is generally called the ventral fin (sympodium), the extent and structure of the dorsal fin,[1] and the form of the posterior end of the body or tail.

The genera may be briefly defined as follows:

Branchiostoma.

Branchiostomids with bilateral gonads, a rayed sympodium, low dorsal fin, and sagittiform expansion of caudal fin membranes.

Contains *B. lanceolatum* and most other species.

Paramphioxus.

Branchiostomids with unilateral gonads, a rayed sympodium, low dorsal fin, and expanded caudal membranes.

Epigonichthys.

Branchiostomids with unilateral gonads, a reduced rayed sympodium, elevated dorsal fin, and expanded caudal fin-membranes.

Asymmetron.

Branchiostomids with unilateral gonads, no sympodium, low dorsal fin, and an extended attenuated tail.

Amphioxides.

Branchiostomids with bilateral (?) gonads, no rayed sympodium (?), low dorsal fin, expanded caudal membranes, and oral cirri aborted (? [2]).

[1] The so-called rays (Actinomimes) and their inclosing chambers (actinodomes) are characteristic of the Branchiostomids.

[2] "Buccal tentacles are absent," according to Günther. If such is really the case, and not the result of a failure in observation, the type is a very remarkable one, and would be an exception to a generally recognized character attributed to the family and even the order in the word "Cirrostomi."

P. S. Shortly before the proof of the present note came to hand, a brief article " On the species of Amphioxus," by J. W. Kirkaldy, became known to me; it is published in the Report of the British Association for 1894 (pp. 685, 686). Three genera are recognized, (1) *Branchiostoma* with 4 species, (2) *Heteropleuron* with 3 species, and (3) *Assymetron* with 1. *Heteropleuron* is a compound of *Paramphioxus* and *Epigonichthys*, and consequently the latter name should have been retained for it. *A. pelagicus* was overlooked by Mr. Kirkaldy as it had been previously by Messrs. Andrews and Willey.

RECENT LITERATURE.

Ord's Zoology.[1]—A patient bibliographic research undertaken by Mr. S. N. Rhoads to unearth a copy of the Second American Edition of Guthrie's Geography containing an account of North American Zoology by Mr. George Ord, was finally successful, and the one copy known to be extant was found in the possession of Dr. J. Solis Cohen of Philadelphia. Through the courtesy of the owner, Mr. Rhoads was allowed to reprint the part relating to Zoology, and in editing the work he has been zealous in reproducing as nearly as possible the style, form, paging, paragraphing, typography and inaccuracies of the original.

The desirability of a reprint of this rare book is evidenced by the numerous applications to librarians for citations from the work.

In an appendix Mr. Rhoads gives the complete titles of the different editions of Guthrie's Geography, some further historical data, and what may be termed a commentary on the species referred to by Mr. Ord. A number of names of American mammalia are settled beyond further disturbance.

A speaking likeness of the eminent naturalist faces the title page, and adds greatly to the interest of the volume.

[1] A Reprint of North American Zoology, by George Ord. Being an exact reproduction of the part originally compiled by Mr. Ord for Johnson & Warner, and first published by them in their Second American Edition of Guthrie's Geography in 1815. Edited by Mr. S. N. Rhoads. Haddonfield, N. J , 1894.

The Life of Richard Owen.[2]—In two octavo volumes of some 400 pages each, the Rev. Richard Owen has given the important incidents in the life of his grandfather, Sir Richard Owen, the leading traits in his character, and a record of his work, including his many important discoveries in anatomy and paleontology. The data upon which the biography is founded are compiled from a voluminous correspondence carefully preserved by Sir Richard Owen, comprising letters received and written, and also from his wife's diary, in which it was her custom to record fully every detail of their joint lives. As may be inferred, the "Life" is extremely interesting. The reader is on terms of intimate companionship from the first to the last page with the subject of the sketch, and is interested by turns in his domestic, social, and scientific character.

The second volume contains Huxley's essay on Owen's position in history of Anatomical Science, and also a Bibliography.

Among the illustrations are restorations of a number of extinct animals, the reconstruction of which occupied so large a portion of Professor Owen's life.

RECENT BOOKS AND PAMPHLETS.

Allen, J. A.—Descriptions of Five New North American Mammals. Extr. Bull. Amer. Mus. Nat. Hist., Vol. VI, 1894. From the author.

Aaron, E. M.—The Butterfly Hunters in the Caribbees. From the Pub., Scribner's Sons, New York, 1894.

Baur, G.—The Relationship of Lacertilian Genus Anniella Gray. Extr. Proceeds. U. S. Nat. Mus., Vol. XVII, 1894. From the author.

Biennial Report of the Director of the Ill. State Laboratory Nat. Hist. for 1893–94.

Brenske, E.—Die Melolonthiden der paleartictischen und orientalischen Regionen im königlichen Naturhistorischen Museum zu Brüssel. Extr. Mém. Soc. Entomol. de Belgique, 1894. From the author.

Bulletin No. 32, Division of Entomology. U. S. Dept. Agric. Washington, 1894.

Bulletins of the U. S. Geological Survey Nos. 97 to 117 inclusive. From the Survey.

Chapman, F. M.—Remarks on Certain Land Mammals from Florida, with a List of the Species known to occur in the State. Extr. Bull. Am. Mus Nat. Hist. Vol. VI, 1894. From the author.

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[2] The Life of Sir Richard Owen. By the Rev. Richard Owen. In two Volumes. New York, 1894, D. Appleton & Co.

CLEMENS, P.—Die Ausseren Kiemen der Wirbeltiere. Aus dem anat. Inst. zu Freiburg i B., 1894. From the author.

CLEVENGER, S. V.—Mysophobia. Extr. Western Med. Reporter, 1894. From the author.

Customs Law of 1894 compared with Customs Law of 1890. Washington, 1894.

DAY, D. T.—Mineral Resources of the United States 1893. Washington, 1894. From the U. S. Geol. Survey.

DEAN, B—A new Cladodont from the Ohio Waverly, *Cladoselache newberryi.* Extr. Trans. N. Y. Acad. Sci., XIII, (Dec., 1893). From the author.

DEVIS, C. W.—The Lesser Chelonians of the Nototherian Drift. Extr. Proceeds. Roy. Soc., 1894. From the author.

FAIRCHILD, H. L.—Proceeds. of the Sixth Summer Meeting, held at Brooklyn, N. Y., Aug. 14 & 15, 1894. Extr. Bull. Geol. Soc. Am. Vol. 6, 1894. From the Society.

HERRICK, C. J.—The Cranial Nerves of *Amblystoma punctatum.* Extr. Journ. Comp. Neurology, Vol. IV, 1894. From the author.

HILL, R. T.—Notes on the Tertiary and Later History of the Island of Cuba. Extr. Am. Journ. Sci., Vol. XLVIII, 1894. From the author.

HOBBS, W. H.—Notes on a Trip to the Lipari Islands. Extr. Trans. Wisc. Acad. Sci. Arts & Letters, Vol. IX, 1894. From the author.

HOLLICK, A.—Fossil Salvinias, including description of a new species. Extr. Bull. Torr. Bot. Club, XXI, (June, 1894). From the author.

HOVEY, E. O.—A Study of the Cherts of Missouri. Extr. Am. Journ. Sci., Vol. XLVIII, 1894. From the author.

KEYSER, L. S.—In Bird-Land. From the Pub., A. C. McClurg and Co., Chicago, 1894.

List of the Scientific Writings of R. H. Traquair.

MASON, O. T.—North American Bows, Arrows and Quivers. Extr. Smithsonian Report for 1893. Washington, 1894. From the Smithsonian Institution.

Matériaux réunis par le Comité d'organization du congres internationaux à Moscou concernant les expéditions scientifiques, les excursions et les rapports sur les questions touchant le congrès. Deuxième et dernière Partie. Moscou, 1893.

MATTHEW, W. D.—The Intrusive Rocks near St. John, New Brunswick. Contrib. Geol. Dept. Columbia Coll., No. XXII. From the author. Extr. Trans. N. Y. Acad. Sci., Vol. XIII, 1894. From the author.

MERRIAM, L. S.—Higher Education in Tennessee. Bureau of Education. Cir. of Information, No. 5, 1893. From the Bureau of Ed.

MILLER, S. A. AND GURLEY, W. F. E.—New Genera and Species of Echinodermata. Bull. No. 5, Ill. State Mus. Nat. Hist., 1894.

——Upper Devonian and Niagara Crinoids. Bull. No. 4, Ill. State. Mus. Nat. Hist., 1894. From the authors.

MCMURRICH, J. P.—A Text-Book of Invertebrate Morphology. New York, 1894. From Henry Holt and Company, Publishers.

PALACHE, C.—Lherzolite-Serpentine and Associated Rocks of the Potrero, San Francisco.——On a Rock from the Vicinity of Berkely containing a New Soda Amphibole. Extr. Bull. Dept. Geol. Univ. Cal., 1894. From the University.

PARKER, L. F.—Higher Education in Iowa. Bureau of Ed. Cir. of Information No. 6, 1893. Erom the Bureau of Ed.

PENROSE, R. A. F.—The Superficial Alteration of Ore Deposits. Extr. Journ. Geol., Vol. II, 1894. From the author.

POHLIG, H.—Sur un important exemplaire du *Cervus* (*Euryceros*) *hiberniae* (Owen). Extr. du Bull. Soc. de Geol., Paleon., et Hydrol. Tome VIII, 1894. ——Le Premier crane complet du *Rhinocéros* (*Caenopus*) *occidentalis* Leidy, l. c. Tome VII, 1893. From the author.

POWELL, L. P.—The History of Education in Delaware. Bureau of Ed. Cir. of Information No. 3, 1893. From the Bureau of Ed.

Press Bulletin No. 66, N. C. Agricultural Experiment Station, 1894.

Proceedings Indiana Academy of Sciences for 1893. From the Academy.

PROSSER, C. S.—Kansas River Section of the Permo-Carboniferous and Permian Rocks of Kansas. Extr. Bull. Geol. Soc. Am. Vol. 6, 1894. From the Society.

RANSOME, F. L.—The Geology of Angel Island. Extr. Bull. Dept. Geol. Univ. Cal., Vol. I, 1894. From the Univ.

RHOADS, S. N.—Reprint of the North American Zoology by George Ord. To which is added an Appendix on the more important Scientific and Historic Questions involved. Haddonfield, N. J., 1894. From the author.

RIES, H.—Microscopic Organisms in the Clays of New York State. Extr. N. Y. Acad. Sci., XIII, (March, 1894). From the Columbia College.

ROTHPLETZ, A.—Geotektonische Probleme. Stuttgart, 1894. From the author.

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SERGI, G.—The Varieties of the Human Species, Principles and Method of Classification. Smithsonian Misc. Coll., 969. From the Smithsonian Institution.

SHUFELDT, R. W.—On the Osteology of certain Cranes, Rails and the Allies, with remarks upon the Affinities. Extr. Journ. Anat. and Physiol., Vol XXIX, 1894. From the author.

SPENCER, J. W.—The Yumuri Valley of Cuba.——A Rock Basin. Extr. Geol. Mag. Vol. I, 1894. From the author.

STEINER, B. C.—The History of Education in Connecticut. Bureau of Ed. Cir. of Information No. 2, 1893. From the Bureau of Ed.

TAFEL, A. J.—Translation of Hensel's Bread from Stones. From the Pub, A. J. Tafel.

Thirteenth Annual Report 1891-92 U. S. Geological Survey, Part III, Irrigation. Washington, 1894. From the Survey.

Transactions of the Congress of American Physicians and Surgeons, Vol. III, 1894.

Visitor's Guide to the Collection of Birds found within fifty miles of the City of New York in the American Museum of Natural History.

WILSON, DR. T.—Man and the Mylodon. Extr. Am. Nat., 1892. From the author.

General Notes.

GEOGRAPHY AND TRAVELS.

The Greenland Scientific Expedition of 1895.—Efforts are now making to raise a fund of $12,000 for the purpose of bringing Mr. Peary and his two assistants home from Northwest Greenland early next fall, and, in connection with this, to prosecute scientific investigations during the available summer season. It is hoped, by this means, to charter and fit out a staunch steamer built for Arctic service and commanded by experienced Arctic navigators, which shall start from St. John's, Newfoundland, on or about July 5, 1895, for Inglefield Gulf, Northwest Greenland, lat. 78° N., Mr. Peary's headquarters. The cooperation of Museums, Scientific and Educational Institutions and individuals is invited, not only because they will thus assist in the return of Mr. Peary and in the preservation of the results of his extended labors, but also because such an expedition will afford the most favorable advantages to eight or ten specialists for obtaining the rich results that are possible in a prolific field that, for a generation to come, may not again be easily and economically accessible.

These Arctic waters have been traversed eight times without an accident by the four Peary expeditions, 1891–94. No Arctic authority will dispute the feasibility of carrying on the work now proposed.

If any members of the party desire to await in the vicinity of Godhaven, Disco Island, the return of the vessel, facilities will be found here for transportation to the neighboring mainland, which, with its ice-cap, its giant glaciers, its great sheets of overflow lavas, its abundant fossil remains, and its large variety of Arctic flora and fauna will reward search with many valuable results.

The vessel should reach the coast of Greenland by July 10 or 12, and should be able to arrive at Mr. Peary's camp late in July or early in August, if it is deemed best to make only few and short stops on the northerly trip. There will then remain four or five weeks for investigations in that exceptionally advantageous region, and still leave some time for work at more southerly points, where, owing to the influence of the East Greenland current, the conditions are unfavorable in the early part of the season. After the severe season of 1893–94, an open passage through Melville Bay and a favorable summer may reasonably be expected this year.

Glacial Researches.—Every scientific member of the four Peary expeditions gives his hearty endorsement of the plans for next summer's campaign. Professor T. C. Chamberlin, head Professor of Geology in the University of Chicago, and a member of the expedition of 1894, writes of the special advantages offered for glacial researches:

"The more I work upon the results gathered last summer, the more I congratulate myself upon having made the trip. The results grow constantly upon me, both in respect of their instructiveness and their fundamental importance. Surely no field is likely to be found which throws clearer light upon the problems of glaciology than the northern portion of Greenland. The facilities for study there presented are truly remarkable. The ends and sides of the glaciers are truncated, revealing their internal nature and their methods of work to a degree that could not well be anticipated."

On Bowdoin Bay, in Inglefield Gulf, Professor Chamberlin found, last summer, nine glaciers of varying forms and habits, within a half dozen miles. It is hardly possible to find any point north of Cape York where glaciers and ice-caps, profitable for study, are not near at hand.

Zoological Work.—The study of marine life should be pursued upon a systematic plan. The results obtained by the Peary Auxiliary Expedition of 1894, clearly indicate that this work may be carried on with profit, and that large additions may be made to our knowledge of marine forms of Arctic life. Mr. C. E. Hite, of the University of Pennsylvania, a member of the Peary Auxiliary Expedition of 1892, says that the dredging results were remarkable for variety and interest. Professor Chamberlin says that, in his opinion, the glacial and biological lines in particular, may be worked harmoniously together. Not a few of our museums desire specimens of walrus, with which these waters abound. In 1893, Mr. Peary secured over twenty of these animals in a few days' hunt. White whale, seal, narwhal, reindeer, Arctic hare, blue fox, birds of various kinds, and insects, may also be procured.

Ethnological Studies.—The Anthropologist can hardly experience anything more instructive than first contact with the native or pure Eskimos, who, by isolation, have been preserved, in all respects, as the most primitive of human beings. They are to be found only in an almost inaccessible district of East Greenland and along the coast line, soon to be visited, between Cape York and Inglefield Gulf. Ethnological collections of great interest may be made at almost every point. The materials furnished by these people would equip a full ward in any Ethnological Museum; and here the primitive phase of

developmental anthropology may be studied with the greatest advantage.

BOTANICAL AND OTHER WORK.—Complete botanical studies in this region, whose flora is developed in considerable variety by the continuous sunlight of a few short months, will be of much interest. It is desired also that artistic and excellent results of photography be secured in large variety. The photographs of glaciers already brought from this region show that nothing can be more helpful to the study of these phenomena than the graphic pictures revealing every phase of glacial activity. This region will afford to all the lines of work here mentioned nearly equal opportunities and very valuable results.

Mr. Peary, who has done great service in opening this interesting region to scientific study, will render every aid in his power to the expedition. His thorough knowledge of the natives, of methods of travel and work, and of points of interest, will greatly facilitate the present undertaking; and, conspicuous among its results, will be the fact that it will bring back, not only the fruits of its own labors, but also the product and records of the able and brilliant explorer who, for several years, has devoted all his time, energy and money to the study of Arctic life and phenomena, and to widening the bounds of geographic knowledge in the North Polar area.

The following resolution was passed by the Council of the American Geographical Society at its meeting on March 2, 1895: "*Resolved*, That the American Geographical Society heartily approves Mrs. Josephine Diebitsch Peary's project for the relief of Mr. Peary, and the prosecution of Arctic scientific research, and that it hereby contributes one thousand dollars towards the expenses of such expedition, provided that other subscriptions, sufficient to make up the sum required to send the expedition, are obtained by Mr. Diebitsch."

The business management of the expedition will be in the hands of the undersigned, Mr. Emil Diebitsch, who was a member of the expedition of 1894.

A limited number of Scientific Societies, Educational Institutions, or individuals, contributing $1,000 to the fund, will be entitled to have each a representative on the Expedition, who shall be approved by the scientific leader. The expenses of each member over and above $1,000, will be the cost of his scientific outfit, transportation from his home to St. John's, and from New York or Philadelphia to his home. The proposed work will require three months.

All communications and requests for further information should be addressed to

EMIL DIEBITSCH,

Business Manager of the Greenland Scientific Expedition of 1895,

2014 Twelfth St., N. W., Washington, D. C.

MINERALOGY.[1]

Recent Books.

Fletcher. The Optical Indicatrix and the Transmission of Light in Crystals.[2]—This treatise is an important one for mineralogical students because of its simple form and style and its easy mathematical demonstrations. It is Fletcher's opinion that, since Fresnel's hypothesis that the medium for transmission of light—the ether—is incompressible, has been shown to be untenable, it should be abandoned by teachers. The newer theory of Neumann and MacCullagh that the ether is compressible, he supports, but wisely advises that since we may be dealing with only an approximate mechanical analogy, it is best to make use of terms which do not commit one to either of the hypotheses. The surface of elasticity he proposes to call the *optical indicatrix.* The wave surface of Fresnel he prefers to call the *ray surface,* and *ray front* is substituted for wave front. The plane passing through the ray and the normal to the plane of polarization, he designates simply as the *transverse plane.* The optic axes of biaxial crystals are called *bi-normals,* and the " secondary optic axes," or directions of common ray velocity, he calls *bi-radials.* The author shows that Fresnel did not, as supposed, arrive at the wave surface as a deduction from his theory of the incompressible elastic ether, but by a simple generalization before his theory of the ether was developed. Chapter II, of Fletcher's work, is devoted to the evolution of the optical indicatrix, and begins by remarkably simple statements of the accepted views concerning the nature of light, its transmission in isotropic media, reflection, refraction, polarization, etc., with the facts on which they are based. The ray surface and indicatrix are then developed from empirical data. It is unfortunate that the printing of the book should have been so badly done. It has been translated into German by Ambronn and König[3].

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] The Optical Indicatrix and the Transmission of Light in Crystals, By L. Fletcher, M. A., F. R. S. Pp. xii and 112. Henry Frowde, London, 1892. (Reprinted from the Mineralogical Magazine).

[3] Die Optische Indicatrix, Eine geometrische Darstellung der Lichtbewegung in den Krystallen, von L. Fletcher, uebersetzt von H. Ambronn u. W. König. Pp. ix and 69. Barth, Leipzig, 1893. Price, M. 3.

Hecht. Introduction to the Calculation of Crystals.[4]—The author of this valuable little book states in his preface that it gives by the method which originated with him, the general solution to the problems which arise in the calculation of crystals, and outlines a course which must, in every case, lead to the result. The necessary mathematical formulæ recommended are not difficult. A simple method is also given for making the stereographic and parallel projections. Numerous examples for practice are included in the book.

Behrens. Manual of Microchemical Analysis.[5]—This most valuable handbook is the best that has appeared treating the subject of microchemical analysis. Its appearance first in English, for it will undoubtedly be translated into German, is especially fortunate for American students. The book was written in English by Professor Behrens and edited by Professor Judd. The introductory chapter by the latter is an excellent resumé of the mechanical and chemical methods of modern petrography. Besides devising many new methods, Behrens has rigorously tested all the older ones, and furnishes data in this handbook showing the reliability and delicacy of each method. He has been careful to insure that errors arising from the differences in conditions of crystallization shall be excluded. As is well-known, the principle of Behrens' method is to get the element to be determined in the form of a sulphate, the basis for the reactions. He insists that micro-chemical reactions, to come into general use, must be suited to work with a minimum of material and secure results in a minimum of time. Part I of the work describes apparatus and reagents and the reactions which determine each element. Part II gives a systematic scheme of analysis, and has special sections for the examination of water, ores, rocks, alloys, and combinations of the rare elements. The book is full of ingenious suggestion, and should be in the library of every petrographer.

Baumhauer. Results of Methods of Etching in Crystallographical Investigation.[6]—Baumhauer, who, more than anyone

[4] Anleitung zur Krystallberechnung von Dr. Benno Hecht. Pp. 76, with 1 pl. and 5 oiled paper charts to be used in stereographic projection. Barth, Leipzig, 1893.

[5] A Manual of Microchemical Analysis, by Professor H. Behrens, with an introductory chapter by Professor John W. Judd. Pp. xxv and 246 and 84 cuts. MacMillan & Co., London and New York, 1894. Price, $1.50.

[6] Die Résultate der Aetzmethode in der krystallographischen Forschung, an einer Reihe von krystallisirten Körpen dargestellt von Dr. H. Baumhauer. Pp. 131, 21 cuts, and an atlas of 12 plates. Wilhelm Engelmann, Leipzig, 1894. Price, M. 16.

else has developed the elegant and accurate methods of etching crystals, gives us in the introduction of this work a most admirable resumé of the work that has been done and the methods that are in common use. Not only etched figures (Aetzfiguren or Aetzgrübchen), but v. Ebner's Lösungsgestalten, Hamberg's Prärosionsflächen, and Becke's Lösungsoberflächen are discussed. The studies of Meyer, Penfield, and Gill, on the forms derived by prolonged etching of spheres of quartz with hydrofluoric acid and the alkaline carbonates, and those of Hamberg on forms assumed by cylinders of Iceland spar etched with hydrochloric acid, are correlated. The author discusses in detail the application of the methods of etching to the determination of isomorphous relations. The greater part of the work is devoted to detailed descriptions of a number of important minerals on which the study of etched figures has been of special significance. Among these are the minerals: cryolite, apatite, Zinnwaldite, dolomite, nepheline, datolite, leucite, and boracite. The plates are particularly beautiful, and are suited to lecture demonstration.

Czapski. Theory of Optical Instruments.[7]—Mineralogists and petrographers who have occasion to test the working or to determine the constants of compound microscopes, will find this recent work of the scientific expert of the Zeiss Optical Works at Jena of much practical utility. The greater part of the work is devoted to a complicated mathematical exposition of Abbe's theories of optical instruments, this latter term being interpreted to include only those instruments which form images of external objects, chief among which are the eye, camera lens, microscope, and telescope. The portion, however, which will find most use among mineralogists and petrographers, is included in the last two chapters. Here the compound microscope, with its modern accessories, is described in respect to construction and use, and methods are given for the practical determination of its optical constants.

Fuess. Instrument Catalogue.[8]—R. Fuess, the well-known goniometer and microscope maker, has issued a supplement to his catalogue of 1891. The supplement treats of goniometers, universal apparatus, microscopes (with many recently devised attachments), grinding apparatus, mounting materials and collections of thin sections.

[7] Theorie der optischen Instrumente nach Abbe, von Dr. Siegfried Czapski. Trewendt, Breslau, 1893. Price, M. 9.60. (Reprinted from Vol. II of Winkelmann's Handbuch der Physik.)

[8] Ergänzungen zum Preis-Verzeichnisse 1891, über krystallographische und petrographische Instrumente, von R. Fuess, Berlin-Steglitz, 1894. Pp. 56.

The catalogue is very greatly increased in value by its references to the literature on the construction and use of each piece of apparatus which it describes.

Klockmann. Text-Book of Mineralogy.[9]—While the English language can boast the best completed reference work on mineralogy—the sixth edition of Dana's System—it is a lamentable fact that it does not possess a single modern class text of the subject. In contrast with this, the Germans have several, the best being those of Tschermak and Bauer. To these has been recently added another by Klockmann, the Professor of Mineralogy and Geology in the Royal Mining School at Clausthal. Klockmann's text is somewhat shorter than any of the others, having but 467 pages (Tschermak, 606; Bauer, 562), but by means of synoptic descriptions and abbreviations in the systematic portions, it is made to include nearly as much material. The book is a very valuable acquisition, and, to the writer of these notes, seem to possess some advantages over either Tschermak or Bauer for the use of its material in the general courses of American universities and colleges. Excellent judgment has been shown in the selection and arrangement of material, and, perhaps, because of the author's position in a mining academy, the minerals which are of economic importance are given more prominence, and more stress is laid upon the geological occurrence and the mineral association than upon the list of localities. The great aid to the memory which the dualistic formulæ furnish seems to be a sufficient reason for making use of them with elementary classes. In view of the general adoption of the index symbols, either alone or with the Naumann's symbols, it will probably be questioned whether it is wise to make exclusive use of the latter symbols in a text-book, but it is difficult to give students familiarity with both systems at the outset without drawing too much of their attention from more important matters, and the student finds it easier to deal with parameters than with indices. The section on the optical properties of minerals is probably the best in the book. In the descriptive portion, symbols, abbrevations, italics, and small type have been used to excellent advantage to aid the eye in referring to the descriptions and to indicate degrees of importance of the subject matter. In the appendix is included, first, synoptical statements concerning minerals of economic importance--ores, gems, etc.; and, second, a key

[9] Lehrbuch der Mineralogie für Studierende und zum Selbstunterricht, bearbeitet von Dr. F. Klockmann. Pp. xii and 467, with 430 cuts in the text. Enke, Stutgart, 1892. Price, M.

for the determination of the common minerals from an examination of their physical properties.

American mineralogists will look forward with interest to the text-book of mineralogy which is now in preparation for MacMillan & Co., by Mr. H. A. Miers, of the British Museum.

W. H. HOBBS.

PETROGRAPHY.[1]

Granite Inclusions in Gabbro.—Inclusions of granite in the gabbro of the Cuillin Hills, Skye, England, afford excellent illustrations of the effects produced by the fusion of acid rocks on a molten basic one. The granite in question is reported by Judd[2] to be a biotite or a hornblende-biotite variety. Near the periphery of the mass the biotite and hornblende are replaced by augite, and granophyre is developed in the interstices between the phenocrysts. The gabbro, in its passage upward, broke fragments from this granite, especially from its peripheral portions, and changed them completely. The granophyric intergrowth was fused and changed to a rhyolitic glass, marked by flow lines and filled with spherulites and lithophysae. In a few instances, some of the larger granophyre groups have escaped complete fusion, in which case, their remnants remain as nuclei of large compound spherulites. Imbedded in the glass are the large crystals of the granite. The quartzes have been cracked, and into the cracks glassy material has been pressed. The feldspars are also cracked, and in the crevices thus formed, secondary feldspars have been deposited. The original augites have disappeared, and in their places are aggregates of magnetite and other secondary products. The most interesting features of the altered inclusions are the spherulites. Simple and composite varieties are both common, and the trichitic kinds described by Cross are also met with. The centers of the spherulites are nearly always grains of quartz or of orthoclase, or groups of granophyre, as already mentioned. Pyrite and fayalite are both new products of the metamorphic action.

The Geology of Pretoria, South Africa.—A long and interesting account of the geology of the gold fields near Pretoria, in the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Quart. Jour. Geol. Soc., xlix, p. 175.

South African Republic, has appeared under Molengraaf's[3] name. The major portion of the paper is taken up with descriptions of the geological features of the region. There are in it, however, several items of petrographic interest. The oldest formation of the region embraces granites and crystalline schists. The former rock-type includes tonalites and orthoclase-plagioclase-microcline granites. In some places the rocks show evidences of dynamic metamorphism. Among the rocks associated with the granite are sericite-schists, actinolite-schists and amphibolites. Above these is another schist formation, comprising quartzites, clay slates, corundum-schists and porphyroids, and chiastolite-schists, cut by diabase dykes. The corundum porphyroid resembles a feldspar porphry. Large crystals of biotite and large corundum individuals are in a groundmass of quartz and chlorite. The whole rock is besprinkled with quartz grains. Above the schists are bedded fragmentals, with which are associated diabases, quartz-porphyres and amygdaloids. In one of the diabases a diallagic augite and a primary hornblende were detected. In the carboniferous sediments south of Reitzburg are quartz gabbro and quartz diabases, and in the Rhenosterkop in the diamond fields at Driekop, in the Orange Free States, is a quartz-amphibole gabbro containing magnetite, biotite, primary hornblende, diallage and plagioclase. The pyroxene is striated parallell to oP, and is twinned parallel to $\infty P\bar{\infty}$.

The Gabbro of the Adirondacks.—The gabbro associated with anorthosites of the Adirondacks are described by Smyth[4] as very similar to the Baltimore gabbros. They are best developed at Morehouseville and at Wilmurt Lake in the valley of West Canada Creek. The rock is a norite, in some phases a hypersthene-gabbro, both containing a brown hornblende regarded as original. The hypersthene, especially in the foliated varieties of the gabbro, which have been rendered schistose by pressure, sends tongues out into the contiguous feldspar. This stringing out of the pyroxene is so closely connected with the development of the foliation of the rock that it is believed to be a dynamic phenomenon. An analysis of the gabbro gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O		Total
46.85	18.00	6.16	8.76	8.43	10.17	2.19	.09	.30	=	100.95

A black garnetiferous hornblende gneiss, which is associated with the other gneisses in the neighborhood of the gabbro, is thought to be re-

[3] Neues Jahrb. f. Miner. B. B., ix, p. 174.

[4] Amer. Jour. Sci., xlviii, 1894, p. 54.

lated to the latter rock, from which it is believed to have been derived by pressure. Around the garnets are rims composed of radiating tongues of hypersthene or of hornblende. Green hornblende is present in the gneiss in addition to the brown variety, and all the other components of the gabbro are represented in either the fresh or the altered condition.

The Dykes of the Thousand Islands.—The granites, gneisses and other rocks of the Admiralty Group of the Thousand Islands in the St. Lawrence River are cut by numerous dikes of a dark rock. These, to the number of thirty, have been studied by Smyth.[5] They are all normal diabases and olivine diabases. In the latter variety the olivine is often surrounded by a reaction rim composed of radiating plates of tremolite. The magnetite in many of the rocks of both varieties is separated from the plagioclase by a rim of biotite. This is absent when the mineral is in contact with the other rock components, hence it is regarded as a true reaction rim between the iron oxides and the feldspar.

Analcite-Diabases from California.—A series of dykes, from San Luis, Obispo Co., California, are described by Fairbanks[6] as consisting of two distinct portions. The main one is dark and fine-grained, and the other a hard, light, rock cutting the former in dykes. Both possess the same general features in the thin section, but the lighter rock possesses them in greater perfection. It consists of lath-shaped basic plagioclase, lamellar diallage and analcite. The latter mineral occurs as irregular masses in the feldspar, in wedge-shaped pieces between the plagioclase, in the form of hexagonal or rounded grains partly enclosed within the feldspars, and as the lining of cavities in the rock. It is supposed to have been derived from nepheline, as the mass analysis of the rock shows it to be very rich in sodium:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	Cl	Total
50.55	20.48	2.66	4.02	7.30	4.24	2.27	8.37	.44	tr	= 100.33

The analcite is changed partly to an aggregate of green fibres, and partly to natrolite. In the wedge-shaped areas between the plagioclase the mineral also contains prehnite crystals, and is bordered here and there by a doubly refracting substance supposed to be a soda feldspar. These are both believed to be alteration products of the analcite.

[5] Trans. N. Y. Acad. Sci., xiii, p. 209.

[6] Bull. Dept. Geol. Univ. Cal., Vol. I, p. 273.

In some of the dykes the structure is ophitic, and in others, panidiomorphic. If the author's view as to the origin of the analcite is correct, these rocks are clearly related to teschnites.

A Quartz-Keratophyre from Wisconsin.—Weidman[7] has investigated the porphyritic rock overlying the Baraboo quartzites of Wisconsin, and has shown it to be a quartz-keratophyre. It shows all the features of a lava, and is associated with tuffs and a sericite schist. The schist is at the contact of the keratophyre with the quartzite, and is evidently a result of shearing of the eruptive. The latter is porphyritic, with plagioclase and anorthoclase phenocrysts (often fractured by movements of the lava), and a few partially dissolved quartz phenocrysts in a fine-grained holocrystalline groundmass of quartz and feldspar, which, in addition to the phenocrysts mentioned, contains imbedded in it ilmenite, biotite and zircon. Many specimens show a fluxion structure and some are spherulitic—the spherules being sometimes secondary and sometimes primary bodies. An analysis of a sample of the rock gave:

SiO_2	Al_2O_3	FeO	CaO	K_2O	Na_2O	H_2O	SO_3		Total
73.00	15.61	1.95	.79	.88	4.95	1.06	.76	=	99.00

The series of bulletins, of which the author's article forms the second number, is well printed and is apparently well edited. It is a valued addition to the list of science bulletins now being published by American colleges.

Notes.—The crystalline limestones of Warren Co., N. J., contain a large number of accessory minerals, which are described by Westgate.[8] It contains irregular masses or concretions of pyroxene, hornblende, magnetite and biotite. Quartz, tourmaline, apatite, graphite and garnet are also present in it. The quartz and pyroxene are so abundant that, in some cases, they constitute rock-bodies, composed of interlocking grains of their principal constituents, with a small admixture of some others.

The nickeliferous pyrrohotite of the Gap Mine, Lancaster, Pa., forms a peripheral zone around the eastern end of an amphibolite lens, which, according to Kemp,[9] is an altered norite or peridotite. The ore is irregularly intermingled with the hornblende of the amphibolite,

[7] Bull. Univ. Wis. Science Ser., Vol. I, p. 35.
[8] Amer. Geologist, Vol. xiv, p. 308.
[9] Trans. Amer. Inst. Min. Engin., Oct.. 1894.

filling interstices between its crystals. The author is inclined to regard the ore as having separated from the rock magma, but, whether in accordance with the Soret principle, or not, he is unwilling to say.

A variolite in a small dyke at Dunmore Head, County Down, Ireland, is described by Cole[10] as an altered glass containing spherulites composed of cryptocrystalline material with a delicately radial structure. Cracks traverse the spherulites and also the groundmass of the rocks. Into some of those in the spherulites glass has been forced. Occasionally the nuclei of spherulites are crystals of plagioclase.

In a general geological article on the Essex and Willsboro' Townships in Essex Co., N. Y., White[11] records the existence of a number of bostonite, fourchite, camptonite and other dykes cutting the country rocks of the region.

GEOLOGY AND PALEONTOLOGY.

The Lakes of Central Africa.—Concerning the origin of the Central African lakes, Dr. D. Kerr-Cross advances the theory that these lakes were in the first instance, arms of the sea, as the Red Sea is at the present time. During Cenozoic time the whole continent participated in a general movement resulting in the crushing, subsidence, faulting, and upheaval which are evident on every hand. The fauna living on during these successive changes has gradually adapted itself to the varying environment. This theory is founded on the following facts collated from the author's own observations, and those of other East African travelers:

1. East Africa is a country of table-lands.
2. Its lakes, Tanganyika, Nyasa, Rulswa, Bangweolo, Newero, and to some extent those further north—not to speak of the lesser lakes—run more or less in the lie of the continent north and south, and are separated from the sea to the east by highland, and are environed by great mountain systems remote from those of the coast range.
3. The lakes are all at high elevation.
4. Some of the lakes have evidence of great volcanic activity having taken place in late geological time. There are recently extinct craters, and hot springs and lava flows.

[10] Geol. Magazine, April, 1894, p. 220.
[11] Trans. N. Y. Acad. Sci., xiii, p. 214.

5. There is a decided parallelism between the lakes and the strike of the mountains, and they occupy vast valleys surrounded by high ground or table-land.

6. The mountains consist chiefly of crystalline and schistose rocks and gneiss.

7. The number of the lakes in the centre of the continent is great, some are salt, some brackish with sodium and magnesium salts, and some are fresh.

8. Most of them have islands.

9. Some are surrounded by markedly escarped hills, with terraces rising from them. Some of these terraces denote a former higher level.

10. In some places the lakes are extremely deep. Notably Lake Nyasa shows great variation of level.

11. The fauna shows a marked resemblance to marine forms. (Geog. Journ., Feb., 1895.)

Structure of Triarthrus.—Additional discoveries relating to Triarthrus give rise to the following observation, by Mr. C. E. Beecher, upon its general organization:

"The simplicity and primitiveness of the trilobite structure will first impress the student. The variable number of segments in the thorax and pygidium in the different genera shows the unstable metameric condition of the class. The head alone seems to have a permanent number of segments and appendages. . . . . . . With the exception of the antennules, all other paired appendages of the animal seem to agree in every point of structure, and vary only in the relative development of certain parts. The appendages of the pygidium are ontogenetically the youngest, and express the typical phyllopodiform structure. Passing anteriorly, the joints become less leaf-like, until in the anterior thoracic legs they are quite slender, and the limbs resemble those of schizopods. Corresponding to this, there is through the whole series, a gradual development of a process from the coxopodite, forming a gnathobase to the limb. On the head these serve as true manducatory organs. Posteriorly, they were like the basal endites of *Apus*, and enabled the trilobite to convey food along the entire length of the axis to the mouth."

In regard to the affinities of the Trilobita, and especially their relations to Apus, Mr. Beecher points out while a general similarity of of the cephalic organs of *Apus* and *Triarthrus* is apparent, yet there are important structural features of other parts of the body in the

latter which are quite dissimilar from *Apus* and the higher crustacea, and the exact relations of the trilobite with any one group cannot be considered as fixed. Points of likeness may be established with almost every order, showing chiefly the relationship between the trilobite and the ancestors of the modern Crustacea. (Amer. Geol., Vol. XV, 1895.)

Land Animals of the Canadian Paleozoic.—The paucity of fossil remains of land animals in the older rocks renders the finding of new material of special importance. Accordingly, the announcement by Sir William Dawson of the discovery of a number of Paleozoic air-breathing animals is of great interest. Forty-three individuals, representing a number of species, have been taken from the interior of two erect trees in the Joggins Coal Mine—the same locality in which the first known Paleozoic land snail was found in 1851.

Descriptions of these remains are embodied by Sir William Dawson in a Synopsis of Air-breathing Animals of the Paleozoic in Canada, up to 1894. The Synopsis contains references to the publications in which the various species have been described, and to their localities, discoverers, and dates of discovery and description. The species described in the Synopsis are distributed as follows:

Vertebrata 26; all Batrachia.

Arthropoda 33; viz., Insects, Scorpions, Myriapods.

Mollusca 5; Pulmonate Snails.

Four of the vertebrate species are named for the first time in this paper—two from osseous remains, and two from foot-prints.

The paper concludes with a note of advice to collectors as to where and how to obtain this valuable Paleozoic material. (Trans. Roy. Soc. Canada, Sect. IV, 1894.)

The Devonian System of Eastern Pennsylvania and New York.—In a paper containing an account of a field investigation of the Devonian system of eastern Pennsylvania and New York, Mr. Prosser takes exception to the terms used by the Pennsylvania Geological Survey and proposes certain changes to bring the correlation of the Pennsylvania section nearer to that of New York. From paleontological data Mr. Prosser has been enabled to compare the formations of this region with the typical sections of the Devonian system of Central New York.

Mr. Prosser finds the Marcellus shale clearly defined, the Hamilton (of White) the Genesee shale (of White) and Tully limestone (of

White) constitute the Hamilton stage; true Genesee shales and Tully limestones are wanting; the Chemung (of White) is found to be Lower Portage; beginning with the Starucca sandstones and New Milford red shales there is a series of deposits equivalent to the Oneonta sandstones of New York; the line of demarkation between the Chemung and Catskill lies at the base of the sandstones overlying the Montrose shales; and, finally, the Mount Pleasant Conglomerate on the Pocono Plateau represents the base of the Pocono.

The classification proposed by Prosser then would be as follows:

Lower Carboniferous	Pocono	Mount Pleasant Conglomerate.
Upper Devonian	Catskill	Mount Pleasant Red Shale. Elk Mountain sandstone and shale. Cherry Ridge Group. Honesdale sandstones.
	Chemung	Portage (including Oneonta) (of Prosser). Chemung (of Prosser).
Middle Devonian	Hamilton	Hamilton (Prosser). Marcellus shales.
Lower Devonian	Corniferous	Upper Helderberg. Cauda-galli grit.

The English Tarns.—While investigating the Tarns of Lakeland, England, with the view of determining their origin, Mr. J. E. Marr discovered that many basins supposed to be rock-bound were in reality not true rock-basins, although the streams issuing from them run over solid rock close to the surface of the lake. The facts as observed by the author are these: Some of the tarns were moraine-dammed at the exit. Should the exit of the lake thus formed immediately overlie the old river-bed, the lake would have a brief existence, for the morainic material would soon be worn away. If, however, the lowest point of the morainic barrier did not lie vertically over the old river valley, the out-let stream would cut rapidly until it reached the level of the rock, and then in the majority of cases would cut sideways along the junction of the rock and the drift until it reached its original position, when the lake would be drained. But if a ridge of rock lay between the position attained by the stream issuing from the lake and the position of the former valley-bottom, denudation would be retarded,

the lakelet would become much more permanent, and its basin would be apparently rock-bound, with its surplus water flowing over a rocky outlet.

Mr. Marr concludes since many of the Tarns he examined are instances of the third class described above, that the lakes of that region, at least, give no support to the theory that the basins in which they occur were hollowed out by ice. (Quart. Journ. Geol. Soc. Feb., 1895.)

The Loess of Northern China.—The superficial deposits of Shantung formed the subject of a paper by Messrs. Skertchly and T. W. Kingsmill read before the Geological Society of London at a recent meeting in which some interesting facts were made known concerning the Loess of that region. The Loess east of the Pamirs is extensively developed over an area of over one million square miles. It is sometimes over 2000 feet thick, and occurs up to several thousand feet above sea-level. Evidence was brought forward by the authors with the intention of establishing the absolute want of connection between the Chinese Loess and the present river-systems, its original stratified condition (as shown by variation of tint and horizontality of layers of concretions) and its subsequent rearrangement to a great extent. The absence of marine shells was discussed, and the suggestion thrown out that the shells had been destroyed by percolating water. The authors gave their reasons for supposing that the Loess is a marine formation, and stated that the sea need not have reached to a higher level than 600 feet above the present sea-level, for the Pamir region where it occurs, 7000 feet above the sea, is an area of special uplift. They maintained that there are no proofs of the glaciation of Northern and Eastern Asia, so that Chinese Loess could have no connection with an area of glaciation. The zoological, ethnological, historical and traditionary evidence alike pointed to the former depression of Asia beneath the sea, and the subsequent dessication of the land consequent upon re-elevation. (Nature, March, 1895.)

Geological News, PALEOZOIC.—In studying the remains of Radiolarians and Sponges in the precambrian rocks of Bretagne, M. L. Cayeux arrives at the following conclusions:

(1). There exists at the base of the precambrian of Bretagne numerous sponge spicules representing many species.

(2). All, or at least nearly all, the orders of the siliceous sponges were in existence at this early period.

(3). The precambrian Radiolarians are the oldest known rhizopods, and of the Sponges the phtanites are the first in point of time. (Revue Scientifique Feb., 1895.)

The zinc deposits in the Galena limestone of the Upper Mississippi are unique in that they occur in practically undisturbed strata that show no evidence of metamorphoric action, and are found in crevices of comparatively limited extent downward. The ores are the carbonate, sulphide and silicate. As to their origin, it is suggested by A. G. Leonard that the zinc comes from the limestones in which occur the crevices. It was deposited along with the sediments by the waters of the Silurian sea into which the metallic salts were washed from preexisting land surfaces. After deposition in the limestome beds the zinc was concentrated in the crevices by the action of drainage water percolating through the metal-bearing beds. (Proceeds, Iowa Acad. Sci. Vol. I, Pt. IV, 1894.)

MESOZOIC.—In commenting on the Sauropodous dinosaur recently found in Madagascar, Mr. Lydekker notes first, that it belongs to a hitherto imperfectly known genus, first described from the Jurassic rocks of England, under the name Bothriospondylus; secondly, the lateral cavities of the vertebræ had no connection with any honeycombing of the interior, and, finally, this fossil completes the evidence that gigantic sauropodous dinosaurs ranged over Europe, India, Madagascar and North and South America during the Jurassic and Cretacic periods. From these facts Mr. Lydekker infers that, since the whole world was inhabited by such closely allied reptiles, the great continents were intimately connected with each other, and the evolution of distinct regional faunas and the separation of large southern island-continents (now, for the most part reunited with more northern lands) took place during the early Cenozoic period. (Knowledge, March, 1895.)

The remarkable resemblance of the jaws and dentition of the Cretaceous fish Erisichthe to those of the Upper Jurassic genus Hypsocormus extends to the pectoral fins and the axial skeleton, so that Mr. A. S. Woodward concludes that Erisichthe is not a "Teleostean" in the ordinary acception of the term, and that none of its known characters warrant its separation from the family to which the Jurassic genera Hypsocormus and Pachycormus belong. (Ann. Mag. Nat. Hist. 1894.)

CENOZOIC.—A revision of the Cenozoic deposits of the Texas Coastal Plain has been made necessary through the accumulation of new

stratigraphic and paleontologic evidence by the State Geologist, Prof. E. T. Dumble. Of the Eocene beds, the divisions below the Fayette are retained, but the Fayette is limited to the basal sandy portion of the beds originally bearing the name, and characterized by the opalized wood it contains. The succeeding clays are called Frio, and they mark the close of the Eocene. The Neocene divisions, beginning with the lowest, are Oakville, Lapara (the coastal representative of the Blanco), Lagarto and Reynosa. The last is a widely distributed bed of gravel cemented by lime and interbedded with clays and limy sands. The basal beds of the Plistocene are the Equus, the direct correlatives of the Equus of the Llano Estacado, which are followed in turn by the Coast Clays, and the Coast Sands. (Trans. Texas Acad. Sci., 1894).

An account of an important find of Mastodon bones (*M. americanus*) near the city of Cincinnati, Ohio, is given by Mr. Seth Hayes. At least three individuals are represented. One complete jaw of an old animal, as indicated by the excessive amount of wear of the last molars presents the unique feature of two mandibular tusks. On Prof. Orton's authority it is stated that the bed from which these remains were taken is of Postglacial origin. (Journ. Cin. Nat. Hist. Soc., Jan., 1895.)

BOTANY.[1]

Notes on Mexican Lichens. I.—Sometime since a quantity of lichen material from Mexico was placed in my hands for study. The collection was made by Mr. Jared G. Smith and Professor Lawrence Bruner on and about Mt. Orizaba, in the latter part of 1891 and in the months of January and February, 1892.

The following annotated list it given as a report of the results of the study of certain genera represented in the collection, and will be followed from time to time by other "notes" as the remainder of the material is worked over.

Ramalina.

R. linearis (L. f.; Sw.) Tuckerm. Trees, etc. Orizaba. (Bruner 50).

This agrees with specimens in hb. Tuck. under this name, but is not the *linearis* of Nylander. Spores straight or curved, $\frac{12\text{–}18}{4\frac{1}{2}\text{–}7}$ mic.

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

R. laevigata Fr. Trees. Orizaba. (Smith 52).

R. denticulata (Eschw.) Nyl. Trees. Orizaba. (Smith and Bruner 53). Spores more or less curved, $\frac{13\text{–}16}{4\text{—}5}$ mic.

R. denticulata canalicularis Nyl. Trees. Orizaba. (Bruner 54).

Differs from the species in being smaller, slenderer, and the main branches becoming divided into many attenuate, channelled branches. Apothecia much as in the species. Spores smaller.

R. calicaris fastigiata (Pers.) Fr. Trees. Orizaba. Alt. 12,000 ft. (Smith 56).

R. calicaris fraxinea (L.) Fr. Trees. Orizaba. (Smith 55).

Apparently not as common as the preceding.

R. pollinaria Ach.? var.? "Trees in forest, slope of Mt. Orizaba, alt. 9–12,000 ft." (Smith 89).

Though this lichen has the aspect of *pollinaria* it differs in being more rigid, larger, and more densely branched, and in having narrower spores. It may prove to be undescribed.

Cetraria.

C. madreporiformis (Ach.) Müll. A single specimen on earth on Mt. Orizaba. (Smith 3).

Evernia.

E. furfuracea (L.) Mann. Trees. N. W. slope of Mt. Orizaba. (Smith 5).

Very plentiful at an altitude of 11,000–12,500 ft.

Usnea.

U. florida (L.) Hoffm. Trees. Orizaba. (Smith 6).

Abundant at 12,000 ft. alt.

U. florida strigosa Ach. Trees. Orizaba. (Bruner 8).

Plentiful.

U. florida mollis (Stirt.) Wainio. On oak trees, slope of Mt. Orizaba at Jalapasco. Alt. 9–11,000 ft. Not uncommon. (Smith 80).

U. florida rubiginea Michx. Trees. Orizaba. Rare. (Smith 79).

U. hirta (L.) Hoffm. Trees. Orizaba. (Smith 7).

U. ceratina Ach. Trees. Orizaba. (Smith 9).

U. angulata Ach. Trees. Orizaba. (Smith 13).

U. longissima Ach. Trees. Orizaba. (Smith 14).

U. cavernosa Tuckerm. "Hanging from branches of oak trees, Jalapasco." Alt. 10–12,000 ft. Abundant. (Smith 15).

This species is sometimes mistaken for *U. plicata,* but may be readily distinguished by the scarcity of fibrils and by the lacunose surface, even when sterile.

Alectoria.

A. ochroleuca rigida Fr. On earth. Orizaba. Common. (Smith 1).

A. fremontii Tuckerm. Trees. Orizaba. (Smith 4). Often mixed with *Usnea cavernosa.*

Theloschistes.

Th. flavicans (Sw.) Müll. Abundant on trees. Orizaba. (Smith 41). This is certainly distinct from *Th. chrysophthalmus* and should be maintained as a species.

Parmelia.

P. perlata (L.) Ach. "Growing on rocks near warm springs," Aguascalientes; Orizaba. (Smith and Bruner 27).

The thallus is not always as smooth as is common in this species.

P. latissima Fee. Trees. Orizaba. (Smith 28).

Thallus sometimes isidiophorous.

P. perforata (Jacq.) Ach. Trees. Orizaba. Common. (Smith and Bruner 29).

P. perforata hypotropa Nyl. Trees. Orizaba. (Bruner 30).

P. cetrata Ach. Oak trees N. W. slope of Mt. Orizaba. Alt. 10–12,000 ft. (Smith 31).

P. revoluta (Floerke) Nyl. Trees. Orizaba. (Smith 33).

P. kamtschadalis americana (M. & F.) Nyl. "On oak trees N. W. slope of Mt. Orizaba." Alt. 11,000–12,500 ft. Very plentiful. (Smith 36).

P. caperata (L.) Ach. On oak trees at Jalapasco. Alt. 10,000 ft. Rocks, Aguascalientes. (Smith 34).

P. conspersa (Ehrh.) Nyl. Rocks. Orizaba; Aguascalientes. Common. (Smith 35).

Some of the specimens from the latter locality belong to the f. *isidiata* Anzi.

Phsycia.

Ph. hypoleuca (Muhl.) Tuckerm. At bases of trees among moss. Orizaba. (Smith and Bruner 62).

Ph. comosa (Eschw.) Nyl. Trees. Orizaba. Common. (Smith 38).

Ph. leucomela (L.) Michx. Trees. Orizaba. Abundant. (Smith 39).

Ph. leucomela angustifolia M. & F. With the preceding. (Smith 40).

Ph. stellaris (L.) Tuckerm. On oak trees at Jalapasco and elsewhere on Mt. Orizaba. Common. (Smith and Bruner 42).

It is often difficult to separate this from the following species.

Ph. astroidea (Fr.) Nyl. Trees. Orizaba (Smith); Cordova. (Smith and Bruner 45).

Ph. crispa (Pers.) Nyl. Trees. Orizaba; Aguascalientes. (Smith 46).

Apparently one of the commonest Physcias in this region.

Ph. major Nyl. Trees. Orizaba; Cordova. (Smith 43).

The specimens agree very well with Nylander's description and with specimens in hb. Tuckerm.

Ph. dilatata integrata Nyl. Trees. Cordova. (Smith 48).

Ph. caesia (Hoffm.) Nyl. A single specimen from Orizaba, infertile. (Smith 44).

Ph. obscura endochrysea Nyl. "On oak at Jalapasco, foot of Mt. Orizaba." Alt. 10,500 ft. A single specimen. (Smith 90).

Ph. setosa (Ach.) Nyl. A single specimen, infertile, collected on trees, Orizaba. (Smith 47).

Umbilicaria.

U. anthracina reticulata (Duf.) Schaer. Common on rocks at 14,000 15,500 ft. Mt. Orizaba. (Smith 81).

This plant is so different from typical *anthracina* that it should, more properly, be regarded as a distinct species.

U. hyperborea Hoffm. "Growing on rocks at lower snow line, 15,000 15,500 ft." Mt. Orizaba. (Smith 59).

U. hirsuta papyria Ach. "Foot of Orizaba." Alt. 15,000 ft. (Smith 60). A single specimen.

U. hirsuta grisea (Sw.) Th. Fr.? Rocks. Orizaba. Alt. 15,000 ft. (Smith 82). This plant is placed here with some doubt. If it is really *grisea* it is certainly distinct as a species from *hirsuta.*

U. vellea (L.) Nyl. With the preceding. (Smith 84).

Sticta.

S. aurata (Sm.) Ach. Trunks of trees, etc. Orizaba. (Smith and Bruner 57).

The specimens are in fine fruit, the apothecia being "ample, marginal, oblique," with a thin inflexed thalline margin.

S. tomentosa (Sw.) Ach.? Orizaba. (Smith 92). Sterile and fragmentary.

S. quercizans (Michx.) Ach. Trees, etc. Orizaba, (Smith and Bruner 58). Sterile. According to Wainio (Lich. Bres. I, 189) this species should be called *St. weigelii* (Ach.) Wain.

S. sylvatica (L.) Ach.? Rocks, etc., among moss. Orizaba. (Bruner 91).

Sterile and fragmentary.

Peltigera.

Pelt. canina (L.) Hoffm. On earth among moss; Jalapasco. (Smith 64).

Pelt. canina spongiosa Tuckerm. "On the ground in dense forest, lower slope of Mt. Orizaba." Jalapasco. Altitude about 12,000 ft. (Smith 65). Well characterized by the tufted fibrils and dense spongy nap of the under surface.

Pelt. rufescens (Neck.) Hoffm.? On ground among moss; Jalapasco. (Smith 66). Sterile and fragmentary.

Pannaria.

Pan. rubiginosa (Thunb.) Delis. Trees. Orizaba. (Smith 24).

Pan. molybdaea (Pers.) Tuckerm. Trees. Motzerongo. (Smith 25). Sterile and fragmentary.

Pan. molybdaea cronia (Tuckerm) Nyl. Trees. Cordova. (Smith 26).

The thallus agrees well with Tuckerman's specimens, but the disks of the apothecia is redder and the spores are somewhat smaller.

Collema.

C. aggregatum implicatum (Nyl.) Tuckerm. Branches of trees; Orizaba. (Smith 16).

C. aggregatum glaucophthalmum (Nyl.) Tuckerm. With the preceding. (Smith 67).

Leptogium.

L. pulchellum (Ach.) Nyl. Trees, etc. Orizaba. (Smith 23).

Spores larger than usual, and much like those of *L. chloromelum* measuring $\frac{25\text{–}36}{8\ \text{–}12}$ mic.

L. tremelloides impresso-punctata Tuckerm. hb. Orizaba. (Smith 19).

Readily recognized by the impressed pits scattered over the upper surface.

L. chloromelum (Sw.) Nyl. Rocks. Aguascalientes. (Smith 22). What is apparently the same thing was collected at Orizaba growing with moss on trees.

L. bullatum (Ach.) Mont. Trees. Orizaba. (Smith 17).

L. phyllocarpum (Pers.) Nyl. Trunks of trees. Orizaba. (Smith 20).

This species is very common and is represented also by several varieties.

L. phyllocarpum isidiosum Nyl. With the species. (Smith 86).

L. phyllocarpum macrocarpum Nyl. With the preceding. (Smith 21).

Apparently one of the commonest varieties.

L. inflexum Nyl. Orizaba. (Smith 18). This species seems well distinct from *L. burgessii.*

L. inflexum isidiosulum Nyl. With the species. (Smith 93).

THOMAS A. WILLIAMS.

The Simultaneous Origin of Similar (or identical) Varieties from Different Stock.—In the summer of 1883, there appeared in a crop of Challenger Lima Beans (a garden form of *Phaseolus lunatus* in which the pods and beans are much thicker than the type), growing near Newark, N. J., a dwarf plant showing no tendency to twine or climb, but in all other respects like the Challenger Lima with its distinguishing characteristics highly developed. Eighty per cent of the seed product of this plant produced dwarf plants, the remaining twenty per cent reverting to the regular Challenger Lima type. Of the product of the eighty per cent of dwarf plants, all, or practically all were dwarf, and thus a dwarf variety of *Phaseolus lunatus* was established.

In the summer of 1884, there appeared in a crop of large White Limas (a garden form of *Phaseolus lunatus* in which the pods and beans are larger and a little flatter than the type) growing near Kennett Square, Penna., a dwarf plant showing no tendency to climb, but in all other respects like the large White Limas. Sixty-six per cent of the seed of this plant produced dwarf plants, and in the succeeding generations practically all of the plants were dwarf, thus giving us a second dwarf variety of the species. The seed from which the Kennett Square crop was grown had been produced on the same farm for several generations, and there is no possibility of the two dwarf sorts tracing back to the same stock within ten generations at least. About the same time there appeared a dwarf form of the very distinct Small White Lima or Seewell, another garden variety of the species, the dwarf plant having all the characteristics of the parent variety except the rank growing twining vine.

Again, the White Plume and Golden Self Blanching varieties of Celery, are of a distinct class of so-called self blanching sorts in which the inner leaves assume in one case a white and in the other a yellow color as the plants approach maturity. There were no such varieties in cultivation until the White Plume appeared in New Jersey and the Golden Self Blanching appeared about the same time in France. There

are many other instances of the appearance at about the same time in different locations and from distinct strains of seed, of a variation previously unknown to the species, and generally each sport retains the general character of the strain from which it sprang, having only the new variation in common.

I have annually, for the past ten years, carefully looked over from 1000 to 2000 acres of cucumbers, and a proportionate area of other vegetables all grown for seed, my object being to note any impurities or tendencies to variation in the stock, and again and again I have found some particular variation, often an undesirable one which I had never seen before, but of which I would find many repetitions during that and the succeeding one or two seasons, after which they would often disappear and give place to some new and equally distinct type. I have often noticed that any particular style of sport common to the season was common to all varieties of the species on which it occurred. I offer no theory in explanation and make no comments, but simply put on record my observations.

WILL. W. TRACY.

Some Features of the Native Vegetation of Nebraska.— The natural vegetation of Nebraska is emphatically that of the Great Plains, and thus differs much from that of the forests to the eastward, and the mountains lying westward. To say that the eastern botanist notes the absence of many familiar plants signifies nothing, since this must always be the case in comparing the flora of one region with that of another. The flora of the plains differs in many things from that of New York and New England, but the eastern man must not unduly magnify the importance to be attached to the fact that he does not find here many of the plants he knew in his boyhood days. The plains have their own plants which will eventually be as dear to the men and women who gathered them in childhood, as are the old favorites to the New Englander transplanted to the west.

A study of the vegetation of Nebraska begun somewhat more than a decade ago, soon showed that it possessed some remarkably interesting features, which my own annual botanizing trips, and the more extended explorations by the "Botanical Seminar" have brought out in stronger light. The native plants of the State are very largely immigrants from surrounding regions. By far the greater number have come from the prairies and forests lying immediately on the east and southeast, creeping up the rivers and streams, or in case of herbaceous plants, blowing overland with a disregard for the water-courses. Thus of the

one hundred and forty-one trees and shrubs which grow naturally within our borders, all but about twenty-five have migrated from the east, in nearly all cases following the streams. Of these twenty-five, about four or five may be considered strictly endemic, the remainder having come down from the mountains. In several expeditions made by members of the "Botanical Seminar" along the Missouri River from the southeast corner of the State to the mouth of the Niobrara River, it was found that many species of trees and shrubs are confined to limited areas in Richardson and the adjoining counties, (in the extreme southeastern corner of the State) and that the number of species decreases with a good deal of regularity as we ascend the river. The same general law is seen as we ascend the three great rivers, the Republican, Platte and Niobrara, which cross the State from west to east. On the other hand, as we ascend the streams, we meet here and there a mountain tree or shrub which is wandering eastward down the slope from an elevation of a mile above sea-level, in the western counties, to less than a thousand feet along the Missouri River. Thus the Buffalo Berry, Golden Currant, Low Sumach, the Dwarf Wild Cherry, and Yellow Pine have travelled half way or two-thirds across the plains; while the Creeping Barberry, Greasewood, Black Cottonwood, Rydberg's Cottonwood, Mountain Maple, Mountain Mahogany, and Sage Brush barely enter the western counties, not extending eastward of the Wyoming line more than a few miles. A couple of species of Wild Roses, the Sand Cherry, and, perhaps, the Sand Plum, appear to belong strictly to the plains.

The grassy vegetation, and the other herbaceous plants present a similar commingling of eastern and western species. Every mile which one advances to the westward brings him in contact with plants not hitherto seen, while at the same time he leaves behind him some familiar species. I know of no other place on the continent where there is a finer illustration of the commingling of contiguous floras than is to be found on the Nebraska Plains. Not a few of the herbaceous species in the southern half of the State have come up from the plains of the southwest, some, even, coming from Texas and New Mexico. Others, again, appear to have migrated from the great northern plains of the Dakotas, while here again there are endemic species, as the Buffalo Grass, Redfield's Grass, False Buffalo Grass, and many of the more showy higher plants.—CHARLES E. BESSEY.

The Division of Agrostology.—Among the things of botanical interest done by Congress, the establishment of the Divison of Agros-

tology in the Department of Agriculture may well be ranked as of most importance. The purpose of this division is set forth as follows in the bill making the appropriation.

"*Investigations and Experiments with Grasses and Forage Plants, Division of Agrostology:* Field and laboratory investigations relating to the natural history, geographical distribution, and uses of the various grasses and forage plants, and their adaptability to special soils and climates; establishment and maintenance of experimental grass stations; employment of local and special agents and assistants; collection of seeds, roots, and specimens for experimental cultivation and distribution; materials, tools, apparatus, supplies, and labor required in conducting experiments; freight and express charges and traveling expenses; the preparation of drawings and illustrations for special reports, and the preparation of illustrated circulars of information, bulletins, and monographic works on the forage plants and grasses of North America, fifteen thousand dollars."

The liberal spirit of Secretary Morton toward scientific investigation is well shown in the wording of the section quoted, and it is a pleasure as genuine as it is rare, to be able to fully and heartily commend an action initiated wholly by a Government official. The wisdom of selecting a man who is more than, and above the mere politician for the Department of Agriculture, was never better illustrated.

CHARLES E. BESSEY.

Gray's Field, Forest, and Garden Botany.[1]—Twenty-seven years ago Dr. Gray brought out the first edition of a book under this name, which has been very widely used in the public schools of the United States, even beyond the territory for which it was intended. The old book had long outlived its usefulness, and a new edition should have been made long ago, but the death of its author delayed the revision until the present time, when from the hand of Professor Bailey we have the rewritten work.

The familiar appearance of the old book is preserved, as well as the general mode of treatment, the sequence of families, etc. In the words of Professor Bailey "it is still Asa Gray's botany, and the reviser has attempted nothing more than to bring it down to date." That this work has been conscientiously done is shown on every page,

[1] Field, Forest and Garden Botany; a simple introduction to the common plants of the United States east of the 100th Meridian, both wild and cultivated. By Asa Gray, late Fisher Professor of Natural History in Harvard University. Revised and extended by L. H. Bailey. American Book Company, New York.

and no man need ask for a more faithful adherence to the spirit of the older book than we find here. Yet this did not prevent the introduction of some modern ideas. We all know how candid a mind Dr. Gray always possessed, and how open it was to the reception of new ideas. Accordingly we find that the relation of the Angiosperms to the Gymnosperms is properly given in the new book, and that the latter are no longer "sandwiched" between the Dicotyledons and Monocotyledons.

Among other improvements to be noted in this edition are, the useful table of contents and the four pages entitled "nomenclature," the latter including valuable biographical data. The citation of the authority for each plant name will be useful in accustoming young students to the practice of botanists, but it is to be regretted that the old method had to be followed. This and a few cases in which an obsolescent nomenclature was followed, show the folly of the publishers in insisting upon too close an adherance to Dr. Gray's views of ten or more years ago. In life Dr. Gray frequently changed his views, as became a candid man of science, and it is an injustice to his memory for the "President and Fellows of Harvard College" to require that his books shall remain essentially unchanged. They would not dare to do so with a work on Chemistry or Physics, why should they for one on botany? When they authorize another edition of Dr. Gray's works they would do well to follow the example of our German friends, who are bringing out a new edition of Rabenhorst's "Kryptogamen Flora."

Professor Bailey has taken much care in the selection of the additions which he has made, and rightly he has given preference to those which are cultivated rather than the wild species. It appears from the reviser's estimates that this edition contains 553 species more than the former one, which represents considerably more than so many actual additions, since some species have been omitted. The new book will be very useful.

CHARLES E. BESSEY.

ZOOLOGY.

Web-Spinning Spiders.—The origin and evolution of web-spinning in Spiders is given by Mr. R. L. Pocock in a recent number of Nature. His theory may be briefly outlined as follows:

Granting the inheritance of silk-glands from an ancestor, the first step in the formation of web-spinning was the formation of the cocoon for the protection of the eggs. This is characteristic of all spiders. The next step would be to extend this protection about herself and the retreat in which the mother had sought refuge while watching over the incipient brood. An aperture would probably be left for ingress and egress, and so arises a rudimentary form of the tubular nest or web which may or may not become a permanent abode for the mother after the dispersal of the young. That this is the second step in the evolution of web-spinning seems supported by the fact that, with the exception of the cocoon, it is the most constant feature in the spinning industry of spiders. At this point there are two developments. Along one is a gradual ascent in complexity until a culmination is reached in the trap-door nest of the wolf-spiders (Lycosidæ) and the bird-spiders (Aviculariidæ); while the other leads to the webs which function as snares, of which the web of the Epeira probably represents the highest type.

From a tunnel-weaver like the Drassidæ which spins a temporary retreat for its breeding season, there are gradations to the web spun by the common house spider, Tegenaria, as an adjunct to its tubular retreat, and thence to the highty specialized orb-weaving of an Epeir, by way of the Nephilengys, a tropical genus, whose net shows a scanty mesh-work of lines arranged radially and concentrically with respect to the mouth of the funnel.

It would seem, according to the author, that the primary influence in guiding the evolution of the architecture of the tunnel-making species has been the necessity for the preservation of life and the avoidance of enemies; while the web has resulted from a struggle for food. (Nature, March, 1895.)

Fishes of the Northwest.—During the summer of 1892, Mr. C. H. Eigenmann obtained a series of collections of the fishes of western Canada and the northwestern United States. The collections were made at 25 different places and include material for a comparison of

the fish-faunas of the streams flowing into Hudson Bay and into the Gulf of Mexico on the Atlantic slope, and into Puget Sound and into the Columbia River on the Pacific slope.

Mr. Eigenmann has worked out the relations that these different river faunæ bear to each other by an elaborate system of comparison, and finds that 6 of the 65 species are found on both the east and west slope of the continent. Of 42 species found in the Winnipeg system 8 are found in the Saskatchewan, and not in the Red River of the North; 16 found in the Red River of the North were not found in the Saskatchewan; 13 of 17 species taken in the Missouri are found in the Saskatchewan. The species of the Saskatchewan, with the exception of the new ones, are all found in the Mississippi basin. 11 Families of the Mississippi basin have not yet been found in the Saskatchewan basin. Only one variety was found in the Fraser that was not found also in the Columbia.

Sixty-five species were obtained, of which 20 per cent. were new to science. They belong to 14 families and 37 genera.

The notable additions to the knowledge of the North American fish-fauna made by these explorations is shown in the following summary of the results of the author's work.

1. A species of Pantosteus (*P. columbianus*=*P. jordanii* of the Missouri) discovered on the Pacific slope.

2. *Noturus flavus* found at the base of the Rockies at Craig, Mont.

3. Four new species of Notropis added to the East Canadian fauna.

4. Two new species of Agosia added to the Pacific fauna.

5. A new species of white-fish (*Coregonus coulterii*) discovered in the Rocky Mountain streams of a restricted region in British Columbia.

6. The family of Percopsidæ found to have a representative on the Pacific slope in the new genus Columbia.

7. Several species of Etheostoma found in Canada, among them two new species.

8. One new Cottus (*C. onychus*) added to the fauna of the Saskatchewan.

9. A new Cottus (*C. philonips*) discovered at Field, B. C.

10. A species of Lota reported from both the Columbia and the Fraser.

11. It was discovered that the fins of the fishes of the Pacific slope vary from the fins of the fishes of the Atlantic slope in definite directions.

12. The extent of variation between the species of any given family of fishes on the Pacific coast was found to be greater than that between the species of the same family on the Atlantic slope.

13. Richardsonius was proved to be a subgenus of Leuciscus. Its species were found to vary directly with the locality. (Art. II, Bull. U. S. Fish Commission for 1894.)

Queer Misfortunes of Birds.—I have noticed in a N. Y. paper, an account of a strange misfortune that happened to an English sparrow at the building of the Edison laboratory, Orange, N. J. The bird became entangled in a twine used in the construction of its nest, and met its death by hanging. This has reminded me of a similar incident that occurred to a bird last summer, near this place, Bowling Green, Ky. It was a common, or crow blackbird, and was seen hanging by the neck, from the limb of a tall tree overhanging the road. Whether in flying with a long grass or string it became entangled with it, or in what way it got caught in the noose and met its death is a matter of conjecture. A queer incident of a woodpecker has come under my notice. The bird, a hairy woodpecker, was seen on a tree trunk and though a stone was thrown towards it to see it fly, it remained in the same position. On going nearer it was found that the bill had been driven into the tree with such force that the bird could not extricate it, and had hung there, meeting a miserable death.

I have heard from a friend of an interesting life history of a mocking bird. It was quite a young bird when purchased from a negro bird-catcher, and it was soon discovered to have sore feet. These were swollen twice the natural size, and though efforts were made to relieve this, it was only after it had lost several of its toes,—two front toes on one foot and one on the other,—that the feet were finally healed. After this it moulted, losing about all its feathers at one time. Its eyes then became inflamed, and the eye-ball like a drop of water, finally closed and the bird became totally blind. In getting its food it would stand at one side of the cage and follow the wires till it reached the food, it would then follow the side of the cage till it reached the water. It soon learned, however, to guage distances and would fly to the perch without fail. It was a pitiable object, but strange to say, this poor maimed bird, lame and blind, developed into one of the finest of singers!

A caged mocking bird here, in moulting, has the new wing-feathers, the primaries at least, reversed; the upper surface turned in or partially so. The owner of the bird has been advised to pull out these feathers, that they would then grow in straight. This would seen rather a severe measure. It would be interesting to know whether this is an accident only to caged birds, or if it ever occurs to birds in a state of Nature.—Sadie F. Price.

The Cotton-Tail Rabbit.—The name *Lepus sylvaticus* proposed by Dr. Bachman in 1837, for the common gray rabbit of the United States, has hitherto been restricted to the eastern region from northern Florida to Canada. A recent investigation of the subject by Mr. Outram Bangs reveals that this region is occupied by two distinct subspecies, for the northern one of which he proposes the name *Lepus sylvaticus transitionalis*, thus restricting the true *L. sylvaticus* to the Carolinian life area. In the same paper the author in referring to the geographical distribution of the northern hare (*Lepus americanus* Erxl.), in the east, points out that the common cotton-tail (*L. sylvaticus*) is continually pushing its way farther to the north and replacing the northern hare. The latter is rare in Massachusetts, has almost wholly disappeared from many parts of New Hampshire, but is still abundant in Maine, New Brunswick and Nova Scotia. Mr. Bangs accounts for the spread of the cotton-tail to the north as a consequence of the destruction of the great coniferous forests, which are replaced by a scrubby second growth of shrubs. The hare goes with the coniferous forests and the cotton-tail comes in with the second growth. (Proceeds. Boston Soc. Nat. Hist. Vol. XXVI, 1895.)

Zoological News, Mollusca.—Mrs. M. B. Williamson reports the successful planting of Eastern oysters in the bays of Los Angeles Co., California. The oysters of Alamitos Bay are as large as those of the same age raised in the East. No star-fish or carnivorous shell fish have been detected in the oyster beds. It is possible that in stocking the beds with eastern oysters may result in planting the fry of other eastern molluscs as well, since *Mya arenaria* L. and *Urosalpinx cinerea* are now propagating in San Francisco Bay as a result of the introduction of Eastern oysters in those waters. (Ann. Pub. Hist. Soc. Southern Cal., 1894.)

Crustacea.—Four new genera of crabs, represented by a number of species, are reported by Mr. J. E. Benedict from the collections made from dredgings in the North Pacific Ocean and Bering Sea, by the Streamer Albatross. Several new species of Lithodes are included in the same collections. A number of young Lithodes, referred by the author to *L. camtschaticus* agree with Brandt's description of *L. spinosissimus*, which, according to the author, was undoubtedly founded upon a young specimen. (Proceeds. U. S. Natl. Mus., 1894.)

Agnatha.—Mr. Howard Ayres does not agree with the commonly accepted theory that *Bdellostoma dombeyi* Lac. is a parastic, degenerate

vertebrate. He asserts that its sense organs represent primitive conditions, showing no anatomical characters that justify a conclusion that they are degraded from a more perfect ancestral condition. A series of experiments has demonstrated also that this vertebrate does not depend upon its internal ears for the equilibration of its body. (Biol. Lectures at Woods Holl, 1894.)

Pisces.—In the revision of the subfamily Sebastinæ of the Pacific coast of America, Messrs. Eigenmann and Beeson have adopted a classification based upon the relation of the parietals to the supraoccipital as a primary character, and the constant presence or absence of certain cranial spines. Under the system 11 genera are defined, to which are referred 52 species. A valuable addition to the paper is a historical list of the species and their present equivalents. (Proceeds. U. S. Natl. Mus. Vol. XVII, 1894.)

Reptilia.—Dr. G. Baur places Anniella in a separate family, the Anniellidæ, close to Anguidæ, and has its closest relative in Anguis itself. In fact, the Anniellidæ are in the same relations to the Anguidæ, as are the Acontiidæ to the Scincidæ. (Proceeds. U. S. Natl. Mus. Vol. XVII, 1894.)

From a study of the herpetological fauna of the islands of Palawan and Balabac Dr. Boulenger concludes that these islands should be regarded as belonging to the same subregion as Borneo. This conclusion was reached also by Mr. A. Everett from a study of the mammals and birds of that district. (Ann. Mag. Nat. Hist. Ang., 1894.)

Aves.—Mr. Robert Ridgway reports 6 more new birds in the Abbott collection from Aldabra, Assumption and Gloriosa Islands. This makes in all 14 new forms from these islands. (Proceeds. U. S. Natl. Mus., Vol. XVII.)

Mammalia.—An Clivedale terrier bitch belonging to a coachman in my brother's employ gave birth to seven puppies, sired by a thorough bred Irish terrier; two of the puppies were born with the tails, just half as long as those of the other five. As for generations the ancestors have had their tails artifically modified, it seems as though this was a genuine case of natural following of artificial type. As the two puppies happen to be male and female it would be interesting to see if the type could be continued.—Allerton S. Cushman.

XXIII.

FIG. 1.

FIG. 2.

Cabbage Root Maggot:

1, Injured Cabbage Roots, ½ natural size; 2, female fly, Magnified.
After Slingerland.

ENTOMOLOGY.[1]

The Cabbage Root Maggot.—In Bulletin 78 from the Cornell University Experiment Station Mr. M. U. Slingerland has brought together the most elaborate account yet published of *Phorbia brassicæ* Bonché. This insect has long been known as one of the most destructive garden pests. It was introduced into "this country from Europe early in the present century, perhaps first appearing in Massachusetts, from whence it gradually spread north, west, and south into the neighboring States. In about 25 years it had reached Maine on the north, Maryland on the south, and Michigan on the west. In 20 years more it had entered Colorado, reached the Pacific Ocean, and passed through South Carolina into Alabama. In a little more than half a century it had thus spread over the greater portion of the United States and Canada. Doubtless it is now present in injurious numbers in every State where its food-plants are grown to any extent.

"Whenever the pest obtains a foot-hold, it usually appears in alarming numbers year after year if its food-plants continue to be grown in the neighborhood. In England it has been very destructive almost every year since 1880. In the United States, the gardeners in this State (especially in the neighborhood of New York City, over the line in New Jersey and throughout Long Island) and in Michigan have suffered severely from the pest almost every year, as the records show, for the past 25 years. Many market gardeners on Long Island have abandoned the growing of early cabbages, cauliflowers, and radishes on account of this formidable pest. In 1887, Peter Henderson said: 'tens of thousands of acres the past season have been, of both cauliflower and cabbage, utterly ruined by maggots.' In Canada the pest has been especially injurious in 1885, 1887, 1890, 1892, and 1893; in 1892 it was considered the most destructive insect of the year."

Concerning the food-plants of the insect, Mr. Slingerland says "that it has been recorded in Europe on the cabbage (including the cauliflower, borecoles, etc.), the radish (*Raphanus sativus* and *radiola*), the turnip (*Brassica rapa*), the ruta baga and swedes (*Brassica campestris*), and on stocks (*Mathiola*); the reported feeding on clover roots and manure needs further confirmation. In this country the Cabbage Root Maggot feeds upon most of the above plants and on at least two common Mustard-like weeds, the Common Winter Cress (*Barbarea*

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

vulgaris), and the Hedge Mustard (*Sisymbrium officinale*); the maggots infesting onions, beans, and raspberry canes are different insects, distinct from each other and from the Cabbage Root Maggot."

The presence of the pest, where it occurs in considerable numbers, is indicated by a checking of the growth of the plant, a tendency to wilt badly under a hot sun, and a sickly bluish cast to the foliage. The way in which the roots are injured is shown in the upper figure of the accompanying plate.

Mr. Slingerland discusses the life history of this and allied species, and treats of the methods of preventing its injuries at considerable length, concluding with an elaborate bibliography and synonymy. The bulletin is illustrated by eighteen excellent figures two of which we are permitted to reproduce herewith.

Ohio Dragonflies.—Prof. D. S. Kellicott publishes a valuable Catalogue of the Odonata of Ohio[2], in which 68 species are recorded for the Central and Northern parts of the State. He thinks the number of species found compares favorably with other Mississippi Valley regions of similar latitude. While lakes, ponds and morasses which are favorable homes for the nymphs of the Odonata are not numerous, many and copious streams traverse the State, and the great Ohio, the Beautiful River, on the south, and Lake Erie on the north, with its numerous estuaries and sheltered areas of reed-grown waters, compensate for the unfavorable conditions of the State at large. Whether or not the number of species is decreasing as a consequence of the profound changes due to more complete occupation of the country by civilized man, it is impossible to know. In all probability, the draining of swamps and ponds, the resulting disappearance, in Summer, of former perennial streams, and the contamination of others, will, sooner or later, produce a material reduction.

"The common names of the adults are often as striking as the forms themselves. In the central and southern sections they are almost universally known as 'snake-feeders;' in the north and northwest, as 'spindles;' in the northeast they are often 'devil's darning-needles.' Still, any one of these, and others, may be heard in any section. Among the less common designations may be mentioned the following: 'horse stingers,' 'mosquito hawks,' and 'dragonflies.' The last, used more or less everywhere, is, by far, the most desirable. It expresses so aptly and happily the characteristics of these veritable dragons of the air. No insects possess a more pronounced individuality

[2] Journal Cincinnati Soc. Nat. Hist., Jan., 1895.

than the Dragonflies; hence, none appeal more strongly to the imagination. Their graceful forms, brilliant colors, and arrow-like flight at once arrest attention and hold the interest; it is, therefore, not suprising that they have received so many and such poetic names. It has been said that "some of these names testify to the wide-spread, but quite unfounded, belief in the harmfulness of these creatures to man." The writer recalls at least one grown person who truly believed they were harmful. This was a school teacher, who impressed upon him, and others of her charge, that the devil's darning-needles about the 'old swimmin' hole' were dangerous, and that they were quite determined to sew up the ears of truants who sought the limpid waters and grass-covered banks of the millrace, rather than the hard and strict ways of the prosy school-room. This is the one 'fact' of Natural History he remembers to have been taught him in the 'district' school."

A Unique Journal.—The Entomological Society of the University of California has recently begun the publication of *The Entomologists Daily Post Card*, especially devoted to the insects of California and adjacent states. It contains synopses, bibliographical references and many useful notes. The subscription price is $2.00 a year, which may be sent to C. W. Woodworth, Berkeley, California.

Loss by Fire.—We regret to learn from Prof. C. H. Tyler Townsend, now stationed at Brownsville, Texas, that he recently lost by the burning of a warehouse at Las Cruces, New Mexico, his valuable entomological library which was especiallly rich in Dipterology. Mr. Townsend would be glad to receive separates of papers from entomologists, who we are sure will willingly help to replace his library.

Male Reproductive Organs of Beetles.—Dr. K. Escherich describes[3] the genital system in the males of Carabus, Blaps, and Hydrophilus. The Carabidæ illustrate the simplest state; a simple blind tube on each side produces spermatozoa, stores the elements and secretes mucus; each tube opens into a somewhat stronger duct, and the two ducts unite in a common ejaculatory canal. The terminal portion in this case is lined with chitin, and is, therefore, ectodermic, not the result of the confluence of the mesodermic vasa deferentia. The region corresponding to testes, vasa deferentia, and seminal vesicle are

[3] Zeitschr. f. wiss. Zool. LVII, 620–41.

mesodermic and Escherich calls them "primary organs." Starting from such a simple case as Carabus the author shows how the endless variety of complications may be reduced to some order, as illustrations of progressive specialization.—*Journal Royal Microscopical Society.*

Lamp Chimneys for Breeding Cages.—Now that the insect season is opening it will be opportune to give some attention to the methods of rearing larvæ.

The common lamp chimney makes an excellent cage for this purpose and one which commends itself by its cheapness as well as by its convenience.

If the larva is to be reared on a small potted plant, the lamp chimney is placed over it and is pressed down into the earth in the pot.

The top may be closed by tying over it a piece of muslin. A watch glass just large enough to lie within the top makes a very neat method. Lantern globes, which may be used in the same way may be closed by inverting tumblers over them.

Potted plants are not always available when the insects must be fed on leaves or stems. These may be kept fresh by putting the stems in water. A cork just fitting the bottom of the chimney is bored so as to hold a homeopathic vial for the water produces a suitable adaptation of this form of cage.—*Entomologists Daily Post Card.*

The Name of the Southern or Splenic Cattle-Fever Parasite.—The generic name given by Drs. Smith and Kilborne, having been previously used in Zoology, must be dropped. I propose the name *Piroplasma* to replace it.

PIROPLASMA BIGEMINUM (S. & K.)

Syn. *Pyrosoma bigeminum* Smith and Kilborne, Repts. Bn. An. Ind. '91–'92 (1893), p. 212, plts. IV–IX.—WM. HAMPTON PATTON, Hartford, Conn.

EMBRYOLOGY.[1]

Ascaris Eggs and Temperature.—Dr. Luigi Sala[2] has applied the experimental method to the study of that classical object, the egg of *Ascaris megalocephala.* He exposed the eggs to a low temperature from 0° to 8° C. for an hour or more and then allowed them to develop under normal conditions of temperatnre, 25 to 30° C.

In such eggs most noteworthy changes are found in the processes of maturation and fertilization. The changes that cold brings forth concern the penetration of the sperm, the structure of the protoplasm of the egg, the formation of the egg membrane, the arrangement of the chromatic substance and of the achromatic substance, the formation of the polar bodies, the formation of the pronuclei and of the first cleavage nucleus.

These results of cold are illustrated by eighty-nine carefully executed figures and cannot readily be described in words, except in most general terms.

The effect upon the egg that may be mentioned under the first category, the penetration of the sperm, are in some cases the prevention of any entrance, but in most cases the entrance of several or even as many as 12 sperms.

That the protoplasm itself is changed is indicated by the fact that its staining reactions are different after the action of cold; while certain changes in optical appearance are also brought about by the same agent. The membrane about the egg is quite noticably different in the cooled eggs; it may be formed but slowly and imperfectly and when formed be changed so remarkably as to fuse with the membranes of other eggs, at least so the author interprets certain monstrous compounds of several eggs enclosed in a common membrane.

The spindels and their sharply marked groups of chromosomes appear in the cooled eggs in quite different guises. The chromatic material may remain in long threads with irregular thickness instead of assuming the characteristic two groups of four sharply circumscribed rods. The number of the chromatic elements is also changed in these abnormal eggs. The achromatic filaments of the spindles assume the most peculiar arrangements in double strands or sheafs, or in crossing

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Archiv. f. Mik. Anat., Feb. 1895.

X-shaped bands, or in multipolar spindles. In some, the appearances point to an active migration of the chromosomes inducing a stretching or dragging of the achromatic filaments.

Many remarkable perturbations appear in the formation of the polar bodies. Contrary to the rule, in Ascaris the first polar body may divide after its extrusion. The polar bodies may be exceedingly large, appearing like blastomeres, and contain more than their share of chromosomes. In one case the polar body had taken all of the eight chromosomes, leaving the egg with the sperm only.

The pronuclei are increased in number when the chromosomes that should enter the polar body remain behind in the egg, since they are modified into small nuclei.

In the first cleavage spindle the number of chromatic elements may be greater than normally results from the fusion of one male and one female pronucleus.

It is thus evident that very abnormal processes may take place in the eggs of Ascaris when exposed to low temperatures.

In attributing so much to the action of cold it must not be forgotten that many such abnormalities have been found in eggs that had never been exposed to such temperatures; it is difficult to say just what are the limits of the " normal" processes occurring under the average conditions.

Isolated Blastomeres in Ascidians.—Hans Driesch[3] has applied his experimental methods to the eggs of the Ascidian *Phallusia mammilata* and found here, as in the echinoderm, that an isolated blastomere may form a complete individual.

When the eggs are shaken in water for only twenty-five seconds some of the blastomeres are so changed that they die and remain as inert masses inside the egg membrane, while the other blastomeres continue to develop. In this way a complete larva may be formed within the egg membrane and adjacent to the dead blastomeres.

Such larvæ arise from one of the first two cleavage cells and are about half the normal size. Otherwise they are like the normal larvæ in being perfect and complete individuals, except that the sense organs and adhesive organs may be in part deficient, as is the case in larvæ reared from whole eggs when exposed to adverse circumstances.

The larvæ are not at all half individuals but whole individuals.

In the cleavage of these separate blastomeres there is never any arrangement of cells to represent half the normal state: the cells form a

[3] Archiv. Entwicklungsmechanik. March 8, 1895.

solid aggregate and do not appear as open or half blastulæ: nor is there any peculiarity about the gastrula stage except its small size. One of the first few cells forms an irregular solid mass by cleavage; one of the first four and also three of the first four cells when left alive also form a compact mass that does not represent a half, a quarter or a three-quarter indivldual, but a whole one.

There is thus no semi-morula.

The chorda dorsalis is like that of a complete egg larva and not a half structure.

The author thus adds the ascidian to the echinus, frog, fish, medusæ and siphonophores as cases in which an isolated blastomere has been found to produce, not a partial, but a complete individual.

It will be remembered that Roux, in the frog, and Chabry,[4] in the ascidian; as well as Chun, in the ctenophores, find cases where an isolated blastomere does not make a complete individual but only a half or a partial one.

The results obtained by Chabry are in Driesch's opinion the same as those he himself has just obtained, though otherwise interpreted by Chabry, Barfurth and Roux.

Considering the differences in the methods employed by Chabry and Driesch we can scarcely expect a very close agreement in the results. Chabry carefully thrust a fine needle into one cell and left the other little disturbed. Driesch violently shook both cells so that one did not continue to live and the other, its equal, must have been much changed in its relation to the first cell as well as internally altered by the mechanical jar.

Frogs' Eggs in Salt Solution.—Professor Oscar Hertwig[5] has applied the method first used by T. H. Morgan in the study of the frog's egg to a more detailed examination of the abnormal results following when the eggs are kept in water containing common salt.

He finds that when eggs of *Rana esculenta* or *R. fusca* are put into water containing from 1 per cent to 5 per cent sodium chloride they develop abnormally; in the stronger solution they are soon killed, in the weaker not for several days.

Larvæ that develop in a 6 per cent solution of salt are abnormal only in the remarkable failure of the blastopore to close, as already noted by Morgan, and in the failure of the medullary folds to close over in the middle region of the brain.

[4] American Naturalis., July, 1892.

[5] Archiv. f. Mik. Anat. 16 Feb., 1895.

The action of weak salt solution is thus apparent as a partial inhibition of the normal developmental processes.

A considerable part of the paper is taken up with a consideration of the differences of view between Weismann and Hertwig, and the application of these new facts to the epigenetic conception of development.

Stimuli in Embryology.—Curt Herbst[6] reviews all the various forms of movements that are called forth in the lower animals and in plants by the action of heat, light, chemical bodies, etc., and known commonly as thermotaxis, phototaxis, chemotaxis, etc., and then advances a plea for regarding such responses to stimuli as important factors in the development of the individual.

Physiological stimuli are thus to be regarded as important factors in the processes of animal ontogeny. Just as a plant or animal cell may move to or away from the source of light, heat or chemical action and just as a plant may bend toward or away from such agents or respond to gravity or to moisture, so, Herbst thinks, may cells and organs in the embryo move or change form in response to various stimuli.

He would thus explain many well known facts; the migration of nuclei to the surface of an insect egg may be the result of positive ærotaxis, that is, the response of the nuclei to stimuli coming from the more abundant oxygen near the surface of the egg. The movements of vitellophags likewise may be the results of definite stimuli.

In later stages the remarkable collecting of mesenchyma cells to invest nerve processes, etc., that is, the formation of the sheath of Swan and the neurilemma as well as the coats of blood vessels may again be due to migrations under the directive influence of stimuli. Even the outgrowth of nerve fibres to the end organs (generally regarded as actually taking place) may not be along the lines of least resistance but controlled by directive stimuli.

All this, it will be observed, is an outgrowth of the observations upon lithium salts and echinoderm larvæ noticed in this journal for December, 1893.

[6] Biologische Centralblatt, Nov., 1894.

PSYCHOLOGY.[1]

Psychical Research.—Mr. Podmore has recently brought out a book in the Contemporary Science Series which seems to have a double object. In the first place, Mr. Podmore is himself fully convinced of the reality of "thought-transference" or "telepathy," as an, as yet, unrecognized agent in communication between mind and mind, and in this little book he marshals the experimental and spontaneous evidence for the hypothesis in an attractive and convincing manner. In the second place, Mr. Podmore thoroughly disapproves of the animistic and the spiritistic tendencies noticeable in much of current "psychical research" and is anxious to show that telepathy is sufficient to account for the phenomena upon which spiritism and animism depend. If this thesis can be made good it will certainly go far to accredit the cause of psychical research in the eyes of contemporary science. The telepathic conception as outlined by Mr. Podmore is sufficiently in line with current scientific conceptions to gain admission to their number, if sufficient experimental evidence is forthcoming to warrant it. It would be, perhaps, more exactly described as a species of "thought-induction," rather than as "thought-transference," and it does not seem hard, so far as *a priori* considerations are concerned, to conceive that the transformations of energy which, taking place in a given brain, are manifested as consciousness may, under conditions at present undetermined, induce in the brain of some other person similar transformations, accompanied by a similar mental state. The adoption of such a conception would not materially affect our general system of thinking in psychology or in other branches of natural science. But when we turn to animism or spiritism, the case is quite different. No amount of evidence will avail to persuade the average man of scientific training that the human consciousness can be separated from its material body and go to and fro upon the earth, becoming cognizant of things at a distance in space from its body and even of past and future events, and occasionally manifesting itself to other human beings as an "astral" form. And the notion that after death the personal consciousness still exists and can sometimes manifest itself to the living, is viewed with scarcely less disfavor. "Evidence" bearing upon such phenomena is usually thrown out of court without consideration.

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

Mr. Podmore has been an active member of the English "Society for Psychical Research," since its founding; he was a personal friend of the late Mr. Edmund Gurney and is probably as much entitled to regard as an expert in the matters of which he speaks as any man living. Moreover, his cautious temper and shrewd common sense make him peculiarly well fitted to deal with questions in which the judgment of most persons is biased by either prejudice or superstition.

The first five chapters of the book deal with the experimental evidence, which Mr. Podmore thinks strong enough to establish the existence of some unknown method of communication. Then he turns to the spontaneous evidence, treating of such phenomena as coincident dreams, veridical hallucination, both individual and collective, cases of reciprocal telepathy, and of clairvoyance in the normal state and in trance. Much of the material adduced in these latter chapters cannot, I think, be fairly regarded as evidence for telepathy, or at least not for the type of inductive telepathy which the experimental evidence would lead us to infer. Much of it can be brought under any telepathic conception only by violent assumptions, and I cannot but feel that Mr. Podmore alleges it, not so much in proof of telepathy as in disproof of animism and spiritism, theories which these phenomena seem *prima facie*, to favor.

In his last chapter, entitled "Theories and Conclusions," Mr. Podmore indulges in some interesting speculations. "This close connection," he says, "of the activity of thought-transference with the subliminal consciousness, the consciousness which appears in hypnosis, and occasionally in dream-life and in spontaneous trance and automatism, may perhaps offer a clue to the origin of the faculty. For the future place of telepathy in the history of the race concerns us even more nearly than the mode of its operation; and we are led, therefore, to ask whether the faculty as we know it is but the germ of a more splendid capacity, or the last vestige of a power grown stunted through disuse. By those who view the matter simply as a topic of natural history, the latter alternative will be preferred. The possible utility of telepathy as a supplement to gesture, etc., at a time when speech and writing were not yet evolved, is too obvious for comment. Whilst, on the other hand, such a faculty can with difficulty be conceived as originating by any physical process of evolution in our modern civilization. But more direct evidence of the place of telepathy in our development is not wanting. For there are indications that the consciousness which lies below the threshhold, with which the activity of telepathy is constantly

associated, may be regarded as representing an earlier stage in the consciousness of the individual, and even, it may be, an earlier stage in the history of the race. The readiest means of summoning into activity this subterranean consciousness is in the hypnotic trance. Now, the consciousness displayed by the hypnotized subject includes, as a rule, the whole of the normal consciousness, and also extends beyond it. That is, the hypnotized subject is aware, not only of what goes on in the trance, but also of his normal life: when awakened, the events of the trance have passed from his memory and are not revived until the next period of trance. Our work-a-day consciousness would appear to be, in fact, a selection from a much larger field of potential consciousness. Or, to put it in another way, the pressure on the narrow limits of our working consciousness is so great that ideas and sensations are continually being crowded out and forced down below the threshhold. The subliminal consciousness thus becomes the receptacle of lapsed memories and sensations; and up to a certain point in the history of each individual these lapsed ideas can be temporarily revived. Long forgotten memories of childhood, for instance, can be resuscitated in the hypnotic trance, and ideas which have demonstrably never penetrated into consciousness at all can be brought to light by crystal vision, planchette-writing and other automatic processes.

"Again, one of the most marked characteristics of the subliminal consciousness, whether in dream, hypnosis, spontaneous trance, or in crystal vision and other automatism, is its power of visualization—a power which, as Mr. Galton has shown, and our daily experience proves, tends to become aborted in later life. And beyond these indications of memories lost and imagery crowded out in the lifetime of the individual, we come across traces of faculties which have long ceased to obey the guidance or minister to the needs of civilized man—the psychological lumber of many generations ago. Such, at least, it may be suggested, is a possible interpretation of the control frequently exercised by the hypnotic over the processes of digestion and circulation and the functions of the organic life generally. And the more doubtful observations, which seem to indicate the possession, by the sub-conscious life, of a sense of the passage of time and of a muscular sense superior to that of the waking state, may be held to point in the same direction.

"From such facts and such analogies as these it may be argued that telepathy is, perchance, the relic of a once serviceable faculty which eked out the primitive language of gesture, and held to bind our ancestors of the cave or the tree in, as yet, inarticulate community. Dr.

Jules Héricourt, indeed, goes further, and suggests that we find here traces of the primeval unspecialized sensitiveness which preceded the development of a nervous system—a heritage shared with the amoeba and the sea-anemone.

"On the other hand, it may be urged that our present knowledge, either of telepathy itself, or of the subconscious activities with which it is sought to link it, cannot by any means be held sufficient to support such an inference as to the probable origin of the faculty, and, further, that the absence of mundane analogies and the difficulties attending any such explanation yet suggested, forbid us to assume that the facts are capable of expression in physical terms.

"It is further urged that whilst the dependence of telepathy on any material conditions is not obvious, it is constantly associated, not only in popular belief, but in testimony from trustworthy sources, with phenomena which seem to point to supernormal faculties, such as clairvoyance, retrocognition, and prevision, themselves hardly susceptible of a physical explanation. This view has found its ablest exponent in Mr. F. W. H. Myers, and although Mr. Myers would himself readily admit that the evidence for these alleged supernormal faculties is not on a par with the evidence for telepathy, yet he maintains that such as it is it cannot be summarily dismissed. No doubt, if it should appear with fuller knowledge that there are sufficient grounds for believing in faculties which give to man knowledge, not derivable from living minds, of the distant, the far past and the future, it would be more reasonable to regard telepathy as a member of the group of such supernormal faculties, operating in ways wholly apart from the familiar sense activities, and not amenable like these, to terrestrial laws. Such considerations may, at any rate, be held to justify a suspension of judgment," and Mr. Podmore concludes with an earnest appeal for more careful experimental work.

I have given this passage *in extenso*, both on account of its interest from the point of view of biology and also on account of the clear statement which it makes of the "stratum" theory which is now accepted as a working hypothesis by many English psychologists, especially those interested in "psychical research." The theory is not without its advantages in explaining the phenomena of hypnosis and automatism, but it is not readily reconciled with our physiological knowledge. Moreover, it involves certain assumptions as to the continued independent existence of subconscious mental states which is wholly unjustified by the evidence. The analogous theory of "co-ordination" or "organization," propounded by Pierre Janet, seems to me

more consonant with the facts and with prevalent psycho-physiological conceptions. Neither theory, however, has as yet been much used by professional psychologists, just as the immense mass of phenomena which the theories would account for, is left unnoticed in most of our psychological text-books. There can be little doubt that when these phenomena are seriously studied by professional psychologists we shall find that the conceptions upon which the science is now based are in need of extensive modification. "Mind" will no longer be a simple, indivisible substance upon which the brain acts and which in turn acts upon the brain, but will be regarded as an exceedingly complex dynamic system, every part of which is what it is only by virtue of the then constituition of all other parts—a system capable of partial or total disintegration and of pathological integration. It is only by recourse to some such conception as this that we can hope to explain these hitherto unknown phenomena, and bring the laws of mind in line with the laws of its material basis, the brain.—W. R. Newbold.

ARCHEOLOGY AND ETHNOLOGY.[1]

Notes on Yucatan.—The expedition sent out in January, by the University of Pennsylvania, had, for its object, the discovery of culture-layers in the caverns of Yucatan. It was thought that proof of man's antiquity in this part of Central America ought to be established by the discovery of refuse beds on the floors of conspicuous, easily-accessible caves, and a group of these shelters, situated in a mountain range, midway between many of the ruined cities, were chosen for exploration, as probably containing evidences of every race that ever visited the Peninsula.

When these cave floors were cut down to bed rock, and when the surface stratum of Maya occupation was sliced through, the work was expected to decide whether other earlier epoch-made refuse beds were to be encountered before the trenches reached rock bottom? This was the main question of the expedition, and the investigation which has, in a great degree, settled it, remains to be described in the report presently to be published by the University of Pennsylvania.

The thanks of the University are due Mr. John W. Corwith, of Chicago, for placing his time and means at their disposal in the under-

[1]This department is edited by H. C. Mercer, University of Pennsylvania.

taking. No less should acknowledgement be made to Dr. S. Weir Mitchell for advice and assistance in the outfit. Important cooperative aid has been furnished by Dr. William Pepper, President of the Association, by Dr. D. G. Brinton and Professor E. D. Cope; while the expedition owes its choice of the Sierra de Yucatan to the geographical help given it by Professor Angelo Heilprin, of the Academy of Natural Sciences of Philadelphia.

Certain notes, taken upon the journey, and not bearing directly upon the results of the work, may interest students. They recall an interesting conversation at Ticul, in February, with Herr Maler, the archeologist, who, coming to Mexico with the French expedition, has remained in Yucatan as a student of its antiquities, ever since.

Nothing, next to the stone work of the ruins themselves, so strikes the explorer in the peninsula as the remarkable predominance of pottery over all other relics of human handiwork. Herr Maler believes that much of the craft of the old earthenware might be relearned and recovered by a study of the work of the present Indian potters. Some of the pots were, he supposed, baked over the constricted calabash, now used as a water bottle, but on none were noticed traces of the potter's wheel. Pottery is found everywhere, but no hunting grounds have proved so rich as the *Chultun*, artificial, clock-shaped cisterns, built by the ancient Mayas, for catching rain-water. He who is staggered at the task of searching for sites of habitation in the stony, thorny, insect-haunted jungles, saves labor by climbing down into these round holes, so often seen in the woods and near mounds, now dry inside. When not repaired for modern use, their plastered floors generally contain two or more feet of rubbish, whence come many of the perfect vases, cups and jars which leave Yucatan. Chief among these is the wide-necked water jar, miniature models of which are sometimes found in the debris; the latter being probably playthings dropped by children into the cistern, and there lost beyond easy recovery in the deep water.

But the ruins themselves, by all means the most conspicuous relics of the past in Yucatan, visited and studied, perhaps, to exclusion of almost everything else, suggest a puzzling question which yet defies answer: How were the stones cut which surprise us by the richness of their ornament? Were the tools used random masses of similar material—chips of the old block, lavishly used to cut the parent stone? Were they the pitted hammer-stones of Mr. McGuire's theory, or chisels made of a harder rock? Were they implements of copper? Whatever any or all of them were, none of them have been discovered in

such a position as to prove their use. Yet, so immense is the amount of the Maya stone work, that the wonder increases as we think of it, and we fancy that the kind of tool we search for, battered and cast away, or well-worn on its cutting-edge, should be scattered about the ruins thicker than potsherds. The only reasonable explanation why not one single such tool has ever been found, is Herr Maler's—that the country is too much overgrown with thicket, too much obscured by uncultivatible stone heaps to make it easy to find anything.

Stone quarries near certain of the ruins where the native limestone had evidently been blocked out for building had been noticed by Herr Maler, and, though a modern quarryman rarely loses tools at the quarry, it is fair to suppose that a careful and prolonged search among the chips at these places might disclose one or two specimens, at least, broken or whole, of the cutting tool sought for. If the implements used were stone, the chance of finding a fragment, at least, is increased, since breakage would have disqualified many specimens for the work. While much stone chipping was undoubtedly done at the ruins, during building, and while there are probably stone-cutters' work-shops undiscovered close by the crumbling walls of Uxmal or Labna, it seems that an overhauling of these isolated quarries in the woods would easiest settle the vexed question.

Herr Maler had found no traces of earlier peoples in Yucatan, such as in Asia and Europe meet the explorer at ever turn. If a more ancient race of builders had preceded the Mayas, then the latter would have used again previously cut stones in their houses. But they did not; all the evidence showing that they originally dressed their building-stone from native rock. That the builders of the ruins lived chiefly on maize, beans, roots, melons and fruit he had little doubt. Flesh they rarely ate, and had no domestic animals except the dog. Of these he believed that there had been several indigenous kinds—one hairless, much used for food by the early Spanish explorers, existing still in Mexico, but now extinct in Yucatan. Another breed he supposed was hump-backed as is indicated by hump-backed figures of dogs, carved on the sixteenth century facade of Governor Montillo's house in Merida.

The explorer has not yet found much to astonish him in the graves of the ancient Mayas. Herr Maler says they lie thick near most mounds, rudely outlined with small rectangles of stone rather than indicated by earth heaps, so there is no way of discovering them when these little rows of stone become scattered, as is now generally the case, save at undisturbed spots in the remote wilds. Under them, skeletons, much decomposed, lie about three feet deep, sometimes in

boxes of undressed slabs, after the manner of the stone graves of Tennessee, but oftener in the open earth. If valuable trinkets of jadeite or nephrite and vases painted with hieroglyphs are not to be found in these tombs, we should hardly know where to look for them. But Herr Maler says that few graves reward search. Of hieroglyphs on vases he had seen several specimens, and showed me one such incised inscription at his house.

The mounds do not repay the explorer as they seem to promise. Instead of containing some tomb altar or enclosed chamber at their very centre, digging proves many of them to be heaps of loose boulders piled up for the purpose of erecting vaulted chambers on their sides and top. These ill-constructed structures have generally crumbled piecemeal into a loose talus that now forms the sides of the mounds, and the tumuli have become round, bramble-covered rubbish heaps, haunted by scorpions and garapatas. As a rule, with few exceptions, there are no graves inside the typical mound, which contains three tiers or steps of the buildings in question, each with its plastered terrace. In the debris of the old floors of these rooms, many interesting fragments of pottery, sometimes showing religious symbolism, sometimes imitating the forms of birds, monkeys and jaguars, have been found.

Of monkeys, Herr Maler believes that there are two or three species in Yucatan. One small earthen monkey head, which he showed me, was truer to nature and less grotesque than other miniature human busts in his collection. Of these latter, one hideous face had been presented to him by a Maya sorcerer at Bolon Chen, as a charm of great value. Obsidian flakes and flint knives, such as he showed me, were rare, since the modern Indians who found them, soon broke or lost them. The flint, of a creamy-white color, he had often found in the native state in swamps. Several earthen cloth stamps showed interesting curved designs, and two earthen whistles blew loud enough to have pleased a boatswain. Strange to say, he had but one arrowhead, but showed me several polished celts, probably of syenite or jadite, from Chichen-Itza, Cozumel, and other places. They were somewhat worn on the cutting edges, but, in my opinion, could not have been used to carve limestone.

Much light might be thrown on the history of the old inhabitants of Yucatan by a study of the modern Mayas, but Herr Maler supposed that the demonic beliefs and practices of the mystic brotherhood, known to students as Naguales, had faded away among the docile people of eastern Yucatan. The word Nagua, a familiar spirit in animal forms, is not used amongst them ; nevertheless, I suspect that interesting results

would reward the investigator of this subject who first mastered the language and then gained the confidence of these people.

—H. C. MERCER.

The Potters' Wheel in Yucatan.—While in charge of the Corwith Expedition of the University of Pennsylvania in Yucatan last month (March, 1895), and while studying the process of pottery making by modern Maya Indians at Merida, I saw a female potter reproduce the chief conditions of the potters' wheel by turning a wooden disc set on a board with her toes. The clay rested on the disc and received the impress of her tools and fingers while revolving. Though the disc was called, in Maya, *Kabal*, it may be doubted whether it is an inheritance by these Indians from their pre-Columbian ancestors and not derived from Spain; in other words, whether its present use demonstrates the existence, till now undiscovered, of the potters' wheel in ancient America.

Doylestown, April 13, 1895. —H. C. MERCER.

MICROSCOPY.[1]

Cytotropism of Cleavage Cells.[2]—The principle of the method employed by Roux is very simple; but the experiments require to be carried out with care, in order to exclude as far as possible sources of error.

The eggs of *Rana fusca*, obtained from newly captured animals at the *beginning* of the normal period of spawning, furnished the best material for observation. Eggs obtained from animals kept separate and thus prevented from spawning at the normal time, proved to be quite unsatisfactory.

The phenomena of cytotropism are seen most readily between cells separated from the egg in the morula or blastula stage. The separation is effected by cutting or tearing the egg in an indifferent fluid, such as the white of a hen's egg, or a ½ per cent salt solution.

One requires for such experiments a small quantity (5–10 ccm.) of freshly prepared white of egg each day. This is prepared by filtering, in an uncut state, through a wad of cotton. The preparation must be perfectly clear.

The egg, in the morula or blastula stage, is first stripped of its gelattinous envelope, and placed on a circular glass plate, about 3 cm. in

[1] Edited by C. O. Whitman, University of Chicago. Contributions should be addressed to the editor.

[2] Wilhelm Roux, Ach. f. Entw'mech. d. Organismen, I, 1, pp. 44–48.

diameter; then covered with about 5 drops of the prepared white of egg, and torn open with two dissecting needles; or, after puncturing with one needle, cut with a small curved pair of scissors. The outflowing parts of the egg are then cautiously reduced in size by a few movements of the needles. The circular plate is then placed in a round glass dish (4–5 cm. in diameter) with a rim 1 cm. high, containing 10–15 drops of water—just enough to fill the space between the edge of the object-plate and the rim of the dish, but not enough to come in contact with the white. The purpose of the dish and the water is to check the evaporation of the medium in which the egg lies, and thus to guard as far as possible against concentration of the medium and currents in the same.

The dish offers the advantage that one, on interrupting the observation, can cover it and so protect the preparation against evaporation. Thus protected, cells may be kept alive in a suitable medium for one or two days.

The preparation should be immediately examined while in the dish with a low objective (e. g. Zeiss A). It is important that the table of the microscope and the object-plate bearing the preparation should be perfectly level.

The examination of isolated cells in an uncovered medium has the advantage that one can easily change the position of the cells with needles or other means. But it is indispensable for checking results to examine also preparations covered with a cover-slip. The cover-slip for this purpose must be large enough, so that at least two of the wax feet ($\frac{3}{4}$ mm. high) supporting it may fall on dry points of the object-plate, where they will firmly adhere and not allow the cover to slide.

A still more complete protection against currents in the medium may be had by having a moist chamber ground into the object-plate and covered with a large cover-slip. The bottom of the chamber must be flat and horizontal.

After separating the cells of an egg, one searches at first with a low power (Zeiss A) to find two cells separated from each other by a distance equal to, or less than, the radius of the smaller cell, and from all other cells by a distance not less than about double the diameter of the cells. No yolk substance should lie between or beneath the cells. Such a pair of cells having been found, higher objectives (Zeiss C or D) may be turned upon them and the cell so adjusted under the ocular micrometer that the line connecting their centres will fall lengthwise of the micrometer. In this position, one can easily see whether the cells move towards, or away from, each other.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The U. S. National Academy of Sciences met in Washington, D. C., Tuesday, April 16th, 1895, and continued in session until Friday the 20th, inclusive. The following papers were read: "On Some Variations in the Genus Eucope," A. Agassiz and W. McM. Woodworth; "Notes on the Florida Reef," A. Agassiz; "The Progress of the Publications on the Expedition of 1891 of the U. S. Fish Commission Steamer 'Albatross,' Lieut.-Commander Z. L. Tanner, commanding;" A. Agassiz; "On Soil Bacteria," M. P. Ravenel (introduced by J. S. Billings); "A Linkage Showing the Laws of the Refraction of Light," A. M. Mayer; "On the Color Relations of Atoms, Ions and Molecules," M. Carey Lea; "Mechanical Interpretation of the Variations of Latitude," R. S. Woodward (introduced by S. C. Chandler); "On a New Determination of the Nutation-Constant, and Some Allied Topics," S. C. Chandler; "On the Secular Motion of a Free Magnetic Needle," L. A. Bauer (introduced by C. Abbe); "On the Composition of Expired Air, and Its Effect Upon Animal Life," J. S. Billings; "Systematic Catalogue of European Fishes," Th. Gill; The Extinct Cetacea of North America," E. D. Cope; On the Application of a Percentage Method in the Study of the Distribution of Oceanic Fishes:" (A) "Definition of Eleven Faunas and Two Sub-faunas of Deep Sea Fishes," (B) "The Relationships and Origin of the Carribeo-Mexican and Mediterranean Sub-faunas," G. Brown Goode; "On the Two Isomeric Chlorides of Ortho-sulpho-benzoic Acid," Ira Remsen; "On Some Compounds Containing Two Halogen Atoms in Combination with Nitrogen," Ira Remsen; "Presentation of the Watson Medal to Mr. Seth C. Chandler, for his Researches on the Variation of Latitudes, on Variable Stars, and for his other works in Astronomy"; "Biographical Memoir of Dr. Lewis M. Rutherford," B. A. Gould; "Relation of Jupiter's Orbit to the Mean Plane of Four Hundred and One Minor Planet Orbits," H. A. Newton; "Orbit of Miss Mitchell's Comet, 1847, VI," H. A. Newton.

The following officers were elected: President, Walcott Gibbs; Home Secretary, Asaph Hall; Foreign Secretary, Alexander Agassiz; Council, G. J. Brush, G. L. Goodale, S. Newcomb, B. A. Gould, Ira Remsen, O. C. Marsh.

The following were elected members: C. O. Whitman, Chicago; W. L. Elkin, New Haven; C. S. Sargent, Jamaica Plain, Mass.; W. H. Welch, Baltimore, Md.

Boston Society of Natural History.—March 20th.—The following paper was read: Miss Grace E. Cooley, "The Reserve Cellulose of the Endosperm of Seeds of the Liliaceae."

April 3d.—The following paper was read: Prof. Harold C. Ernst, "The Antitoxine of Diphtheria."

—SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington.—March 9th.—The following communications were made: Dr. C. W. Stiles, "A Double-pored Cestode with Occasional Single Pores;" Mr. Theo. Holm, "Oedema of Violet Leaves;" Dr. Geo. M. Sternberg, "Explanation of Acquired Immunity."

March 23d.—The following communications were made: Mr. Chas. T. Simpson, "On the Respective Values of the Shell and Soft Parts in Naiad Classification;" Mr. F. V. Coville, "Remarks on the List of Pteridophyta and Spermatophyta Growing Without Cultivation in Northeastern North America;" Dr. C. W. Stiles, "Two Cases of Adult Cestodes in *Sus scrofa;*" Prof. Joseph F. James, "Remarks on *Dæmonelix* and Allied Fossils." —FREDERIC A. LUCAS, *Secretary.*

SCIENTIFIC NEWS.

The province of Ontario is to have a great reservation for the preservation of its native animals and plants. The Algonquin Natural Park will comprise about a million acres of forest land. No hunting, trapping or destruction of animal life will be permitted within its precincts.

Dr. G. M. Dawson has been appointed to succeed Dr. A. R. C. Selwyn as Director of the Geological Survey of Canada.

An Austrian Expedition, under the direction of M. Julius von Payer, has been organized for Polar research. The present plan is to start for the eastern shore of Greenland in June, 1896.

A course of Popular Science Lectures, given under the auspices of the Ethical Society of St. Louis in the Grand Opera House of that city during the past winter, includes the following subjects: About Birds, or Life in the Air, Mr. Frank M. Chapman; The Native Races of North America, Mr. Frederick Starr; Explorations and Experiences in the Arctic Regions, Prof. Angelo Heilprin; About Fishes, or Life under the Sea, Prof. E. D. Cope.

The literature of games, a subject which has come prominently before the public since the remarkable exhibit of the games of all countries shown by Stewart Culin, in the Anthropological Building at the Columbian Exhibition at Chicago, will shortly receive a noteworthy addition in a work on "Korean Games," by Mr. Culin and Mr. Frank Hamilton Cushing, of the Bureau of Ethnology, Washington. The special field of Korea has been selected for illustration from the remarkable survivals that are found there. Mr. Edward B. Tylor bases his argument as to the Asiatic origin of Aztec culture largely upon the similarity of the Mexican game of Patolli with the Hindoo game of Pachsi. The resemblances which he noted will be shown to practically extend over all culture, and a theory of the origin of games formulated as the result of a searching examination of the games of all people. The book will be published by subscription as an edition de luxe, with twenty-two full-page colored plates from brilliant pictures by a skillful Korean artist, and with native sketches in black and white, of corresponding games of China and Japan.

Natural Science will be published hereafter by Messrs. Rait & Henderson Co., No. 22 St. Andrew St., Holborn Circus, London, England.

Professor James Dwight Dana, the eminent geologist, who for fifty years was a professor at Yale University, died at 10.30 P. M., April 14, 1895, of heart failure, aged 82 years.

Professor Dana had been ill for about eight weeks, but had, however, been able to be about on the streets attending to his usual routine. On Friday after being out for a walk he returned to his home slightly indisposed. The family physician, Dr. J. P. C. Foster, was summoned, but after making an examination said that the Professor's illness was nothing serious. Shortly after 10 o'clock that night (April 14th), however, there was a change in Professor Dana's condition and, becoming alarmed, the members of the household sent for the physician. Dr. Foster went immediately, but when he arrived at Professor Dana's residence he was dead.

Although well advanced in years Professor Dana was very active. He was a familiar figure about the streets of New Haven, as his daily routine was commenced with a visit to the post office for his mail.

When he resigned his position as professor of geology and mineralogy, the action was forced by his family because of the decline of his health. He had previously been asked by his friends in the University to give his work up, but he declined, preferring to continue. He was succeeded by Professor Henry S. Williams, of Cornell.

James Dwight Dana was born Utica, N, Y., February 13, 1813, and was graduated at Yale in 1833. He was appointed instructor of mathematics in the United States Navy, in which capacity he visited many remote parts of the world. In 1836 he returned to Yale as assistant in chemistry to Professor Benjamin Silliman. In 1838 he went with the United States exploring expedition to the Pacific, under the command of Captain Charles Wilkes. His reports on the Crustacea collected by the expedition, and on the geology of the regions visited are standard authorities on these subjects throughout the world. He did much important local work in Massachusetts and Connecticut. He was a defender of the doctrines of the permanency of continental nuclei, and of the glacier theory of the glacial phenomena of the Plistocene system.

In 1850 he became associate editor of the "American Journal of Science and Arts." The Geological Society of London in 1872 conferred upon him the Wollaston medal.

Professor Dana's works in book form include "System of Mineralogy," 1837; "Manual of Mineralogy," 1848; "Coral Reefs and Islands," 1853; "Manual of Geology," 1863; "Text Book of Geology," 1864; "Corals and Coral Islands," 1853; and "The Geological Story, Briefly Told," 1875.

A joint meeting of members of the University of Pennsylvania, the American Philosophical Society, and the Academy of Natural Sciences, was held in the hall of the Academy of Natural Sciences on the evening of Wednesday, April 10, in memory of the late Professor John A. Ryder. General Isaac J. Wistar presided, and Philip P. Calvert acted as secretary. Addresses were made by Dr. Harrison Allen on "Dr. Ryder's Relation to the Academy of Natural Sciences;" Dr. Bashford Dean, of Columbia College, on "Dr. Ryder's Work in the U. S. Fish Commission;" Dr. Horace Jayne on "Dr. Ryder and the School of Biology;" Professor E. D. Cope on "The Evolutionary Doctrine of Dr. Ryder;" H. F. Moore on "Dr. Ryder as a Teacher," and Dr. W. P. Wilson on "Dr. Ryder as a Collegian." The speakers all bore testimony to Prof. Ryder's merits as an investigator and as a teacher, and to his amiability and honesty as a man.

Charles D. Wolcott, of the United States Geological Survey, has had conferred upon him the Bigsby medal of the Royal Geological Society of England.